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FIRST LOOK AT HAL:
1-2-3 LEARNS ENGLISH

# MAGAZINE

LUME 5 NUMBER 21
CEMBER 9, 1986

## Special LAN Issue

*Hands-on and in-depth:*
*NetWare*
*StarLAN*
*G/NET*
*S-Net*
*ProNET-10*
*ARCnet*
*TI's LAN Server*

*Step-by-Step Decision Guide*

*Professionals' LAN Primer*

Hard Disk Tips:
More Speed, More Space

Dvorak's Inside Track on the 386

49

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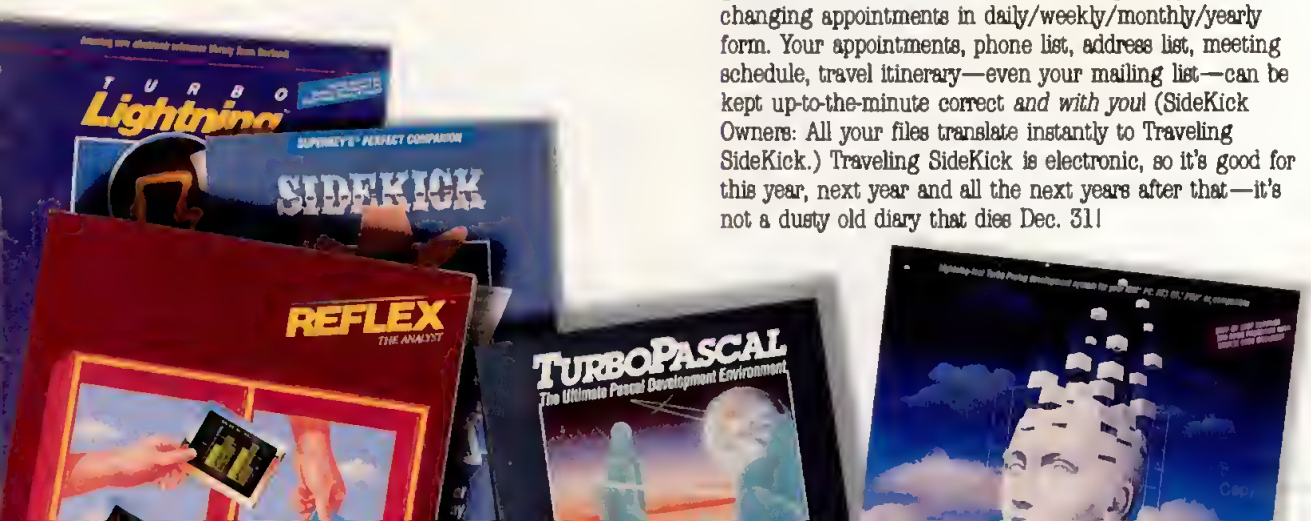

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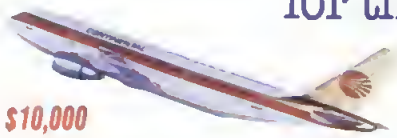

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PC MAGAZINE

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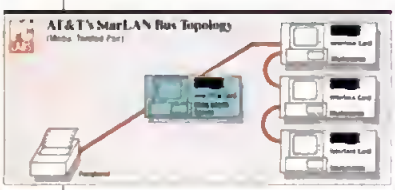


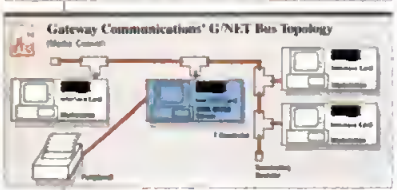


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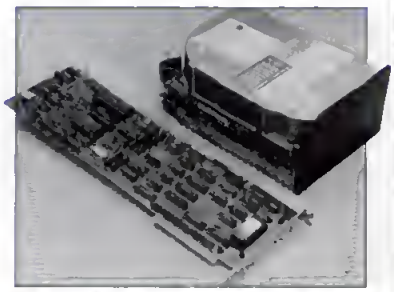

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**Cover Photograph:**
Roberto Brosan

# WHAT'S INSIDE

Frank J. Derfler, Jr

At a recent seminar on local area networks, associate editor Cheryl J. Goldberg, who managed the cover story for this issue, queried consultants and microcomputer support people on why they wanted to learn about LANs. Many cited the traditional reasons for networking: equipment and data sharing. But others said PC users at their companies keep hearing the buzzword *connectivity* at trade shows and seeing it in magazines, and they want it simply because it's the hot new technology.

After 3 years of false starts, the Year of the LAN has arrived; only now micro-to-mainframe links come under the catchphrase "connectivity." According to Future Computing, nearly a million network interface cards were sold in 1986, more than twice as many as in 1985. Driving the hardware sales spurt are the Sytek/IBM NETBIOS and DOS 3.1 file- and record-locking standards, which have allowed software developers to design LAN applications, and new gateways that hook LANs to mainframes.

Unfortunately, networking is a complex subject to understand, and LANs can be surly products to use. This issue inaugurates *PC Magazine*'s intensified coverage of connectivity with a primer on LANs and reviews of a half-dozen of them. "Connectivity: LANs and Beyond" (page 118) introduces you to the components of a LAN. "The Software Key to LANs" (page 131) explains what networking software does and how it provides the features a user sees. For a broader view of connectivity, you'll find a discussion of networking options, ranging from disk swapping to simple circuit-switching systems to LANs and minis and mainframes in "An Overview of Networking Options" (page 141).

Power users ready to make a LAN decision can consider the reviews and benchmark tests of Novell's *NetWare* and six LANs running under *NetWare* in "Making Connections: LANs Under NetWare" (page 149). "A Networking Tool Kit" on page 191 lists batch files to make a network administrator's job easier.

Since so much can go wrong when evaluating a LAN, PC Labs chose to take the time to do the testing right. Rather than cramming reviews of every LAN into one issue, we will review them in a series that will continue for most of 1987. The series will also cover other options, such as micro-to-mainframe links and gateway connections. To ensure continuity, we're using the same test-bed of equipment for each review and have brought in our connectivity guru, contributing editor Frank J. Derfler, Jr., (pictured above) and his team of assistants to perform all the testing. Derfler lectures, writes, and consults extensively on issues of connectivity for both the government and the private sector.

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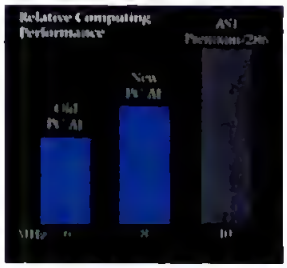


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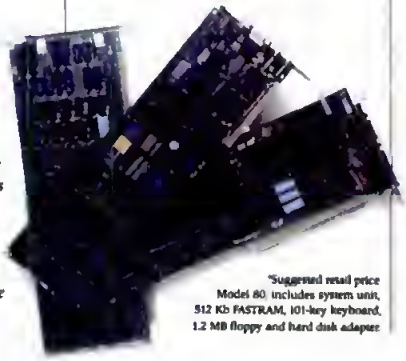

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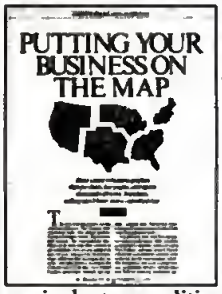
# LETTERS TO PC MAGAZINE

### PUT IT ON THE MAP

In her review of PC mapping packages ("Putting Your Business on the Map," *PC Magazine*, Volume 5 Number 16),




Carol Olsen Day states that *MapMaster* has files to map Louisiana by county. Louisiana, however, has no counties. As the result of a somewhat bizarre historical legacy, Louisiana's equivalent geopolitical units are called parishes. This easily made error, however, did not detract from Day's excellent and much-needed review in the least.

John E. Johnston III
Baton Rouge, Louisiana

### MODIFYING PROGRAMS

I wish to express my appreciation for the excellent contributions your staff programmers and contributors are making in the Programming/Utilities, Power User, User-to-User, and PC Tutor sections of your magazine. I always turn to these sections first.

My greatest admiration goes to Charles Petzold, whose imaginative and original programs are particularly useful. The BROWSE, DDIR, DOS-EDIT, KEYFAKE, SWEEP, and VTREE programs are all gems. I do, however, wish to point out a minor bug in BROWSE.COM (Programming/Utilities, *PC Magazine*, Volume 5 Number 6). Apparently, depending on the length of the file, the last PgDn that BROWSE.COM will accept may bring up a blank screen. This is not a serious matter when one realizes that the PgUp or Home key will bring the screen back to life again. Nevertheless, it is a flaw in an otherwise perfect and extremely useful program. Can Mr. Petzold publish a patch?

N. W. Tschoegl
Pasadena, California

The SETUP.COM utility featured in your Programming/Utilities column (*PC Magazine*, Volume 5 Number 12) is a magnificent and useful program—that one program alone is worth the price of an annual subscription to *PC Magazine*. Printer codes have always left me confused, and even when I do muddle through them, I quickly forget them if I don't use them for several days. Now, with SETUP.COM, I can forget about keeping all that information memorized.

However, I would like to modify SETUP, adding codes such as italics to the menu and removing some of the options already included with the utility. I must admit that, unfortunately, the explanation on how to modify it was a bit over my head. Is there any way I could get some simpler or more detailed instructions on how to modify SETUP?

Mike Caddell
Richardson, Texas

*Every time we publish a programming column, our readers deluge us with suggestions for expanding or modifying the features. Unfortunately, space limitations make it necessary for us to keep programs short, without fancy opening screens or long-winded error messages. While we can't meet each individual's specifications, we do include the assembly language source code with every utility to make it possible for programmers to customize the code. We also provide .COM files and text to explain how the programs are constructed and how they operate. The utilities may not do everything our readers would like, but they are awfully powerful for such compact programs.—Ed.*

### ACCELERATOR BOARDS ARE A HIT

I would like to thank Charles Petzold and Stephen Davis for their excellent articles on accelerator boards ("Accelerator Boards: Power for a Price" and "The No-Slot Alternative to Acceleration (And Why It Makes Sense)," *PC Magazine*, Volume 5 Number 15).

Many users for whom it is not cost-effective to upgrade to a faster machine but who can afford to invest in an accelerator board would benefit from the articles. They clearly explain the differences in the various popular designs, as well as clearly compare (in words and graphs) the available products.

I would like to mention, however, a no-slot board that I think may be the best buy on the market—the PC-Sprint from EXEC-PC. The PC-Sprint plugs into the clock socket, runs at a maximum rate of 7.38 MHz, and provides a hard reset switch that can be externally mounted. All my software seems to run with it perfectly at the highest speed.

Rick Sidelnik
Austin, Texas

*Thank you for your compliments. We are considering reviewing PC-Sprint in a future issue.—Ed.*

You are to be commended for clarifying

# Boost cursor speed.

# Stop cursor run-on.

With all the recent hoopla over performance, it's ironic that two of the PC's ergonomic deficiencies have been overlooked — its slow cursor, and the tendency of the cursor to remain in motion (run-on) after a cursor key has been released. Finally, the solution — Cruise Control™ from Revolution Software.

Cruise Control is a new productivity tool for serious PC users. It boosts cursor speed, typically by 3-5 X. It eliminates annoying cursor run-on. And it adds hands-free cursor navigation to any application.

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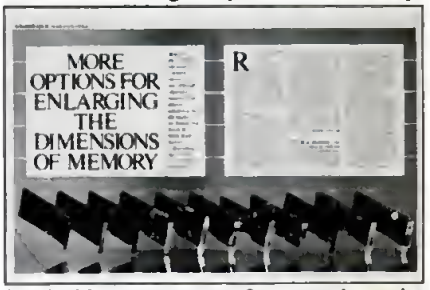
## ■ LETTERS

the confusing subject of turbo boards for the IBM PC in "The No-Slot Alternative to Acceleration (And Why It Makes Sense)." As an XT user at home, I have always been frustrated by my computer's lethargic performance, but whether to upgrade to an AT or invest in one of these turbo devices had been a subject of great debate with my colleagues. After reading your article we installed MicroSpeed's Fast88 and have found working with the XT a bit more pleasant.

Richard Watanabe
Los Angeles, California

### ALL CARD ALL WRONG

In the article "More Options for Enlarging the Dimensions of Memory" (*PC Magazine*, Volume 5 Number 11), Charles Petzold makes some serious errors, mostly by omission, and is grossly unfair and damag-




ing in his assessment of our product, the All Card. What I find totally baffling about the article is how anyone who understands, and expounds so meticulously on, the inner workings of extended memory with memory management units (MMUs) can be so casual about the shortcomings of expanded memory with bank-switching and about the phenomenal benefits of a well-designed MMU with today's versions of DOS. The result is that Mr. Petzold is misleading on some of the most important issues facing the buyer who hopes to go beyond 640K with a new memory expansion board.

The most important omission from the article is an acknowledgment that the All Card with its MMU provides extended memory that works with current versions of DOS. As a result, All Card users have the unique ability to upgrade its hardware features simply by getting a new version of software. Early users of the All Card can upgrade with software at no cost and run all the specs, including the Lotus/Intel/Mi-

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## ■ LETTERS

crosoft expanded memory specification, that break 640K.

Mr. Petzold also makes the incorrect assumption that video must be modified in order to derive any benefits from extended memory. The All Card can run programs conforming to EMS and other specs, as well as resident programs in the same extended memory, without any video modifications. While some earlier bugs in our software made it more difficult to deal with the more advanced usage of our product by modifying video, our current version has eliminated the known bugs and is simpler to use. The problems that Mr. Petzold cited were primarily due to earlier bugs rather than to the complexity of using modified video.

Mr. Petzold's completely negative attitude toward the All Card is best exemplified by his statement: "The board's packaging heralds it as 'a lifetime investment' with 'expanded growth potential.' This for a board that is not compatible with EGA?" Correcting Mr. Petzold, the All Card is actually fully compatible with EGA when running either with or without larger DOS and EGA.

Finally, there are several other errors made in the charts accompanying the article. For example, the Benchmark Tests chart incorrectly states that the All Card does not include a RAMdisk with EMS. Also, the Summary of Features table should state that the maximum memory on-board is 6 megabytes, the maximum memory with two boards is 9 megabytes, and extended memory is provided with the All Card.

In closing, I would like to say Mr. Petzold is certainly free to pick Intel Corp.'s Above Board/PS as his choice, but we ask that we be treated fairly and readers be given the facts on all the important and costly issues so that they can arrive at their own intelligent conclusions.

Mers Kutt
President
All Computers Inc.
Toronto, Ontario
Canada

Charles Petzold replies:
*Thank you for your comments. The factual information in my review of the All Card was correct for the product All Computers sent us for evaluation. I stand by my assessment of the board and my conclusions.*

### RESPECT FOR SUPERCALC

Your article "SuperCalc4 Stalks 1-2-3" (First Looks, page 33, *PC Magazine*, Volume 5 Number 15) was short but commendable—finally, *SuperCalc* gets some respect.

However, your Spreadsheet Clinic is misnamed, in my opinion. A true, unbiased spreadsheet clinic should include not only tips for *1-2-3*, but tips for other popular spreadsheet programs as well. May I encourage you to either expand your column to include other programs or begin a new column for *SuperCalc* users?

Ronald D. Jackson
Foster City, California

*The Spreadsheet Clinic column is composed entirely of reader submissions, the overwhelming majority of which are* Symphony *and* 1-2-3 *hints. We print the best tips and advanced techniques that we receive, and we would love to hear from* SuperCalc *users or power users of any other popular spreadsheets. "Contribute to the Clinic" pertains to every spreadsheet user.—Ed.*

### CORRECTIONS

MicroSpeed, makers of the Fast88 accelerator board ("The No-Slot Alternative to Acceleration (And Why It Makes Sense)," *PC Magazine*, Volume 5 Number 15), has changed its address. The new location is 5307 Randall Pl., Fremont, CA 94538.

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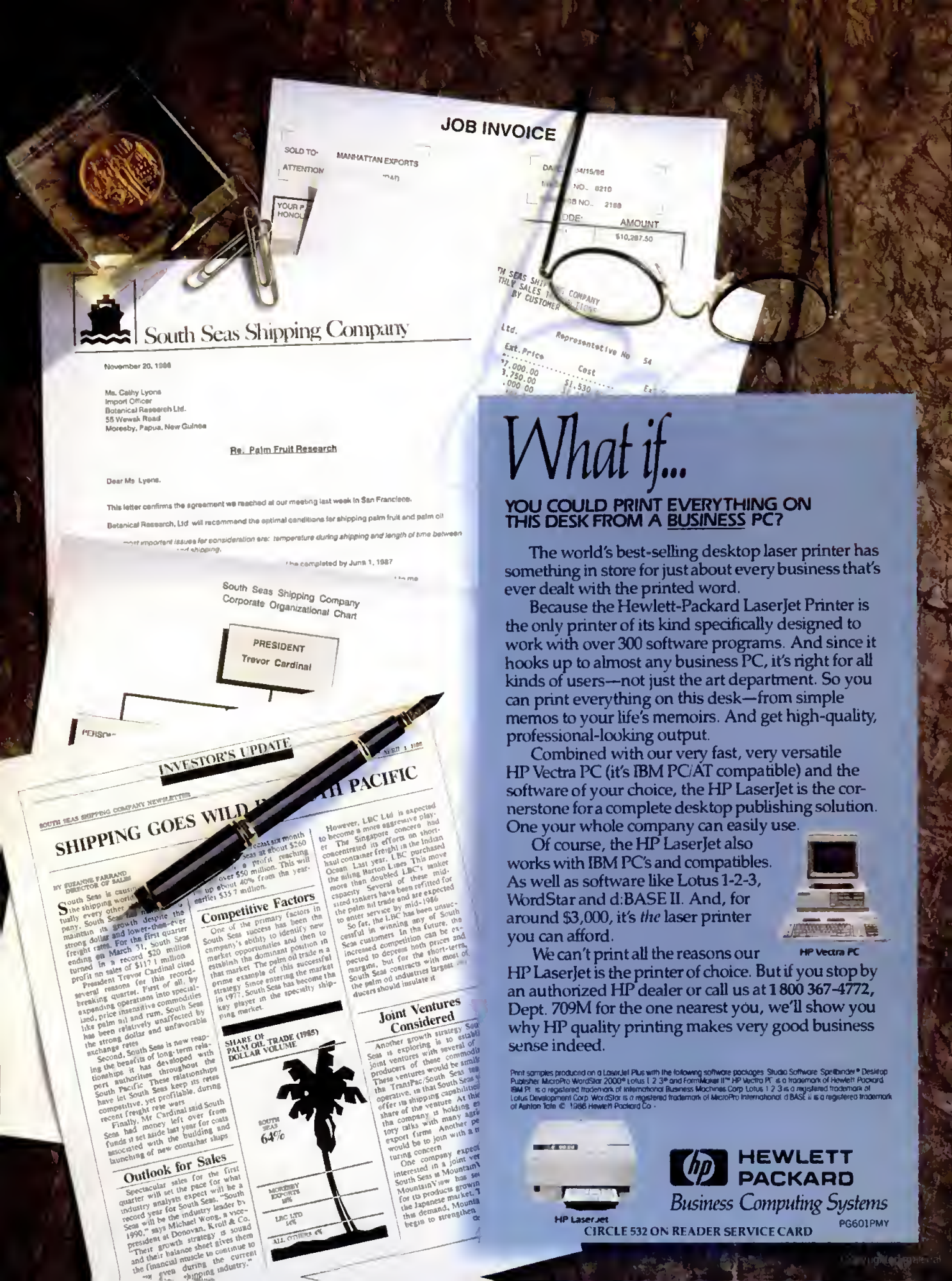


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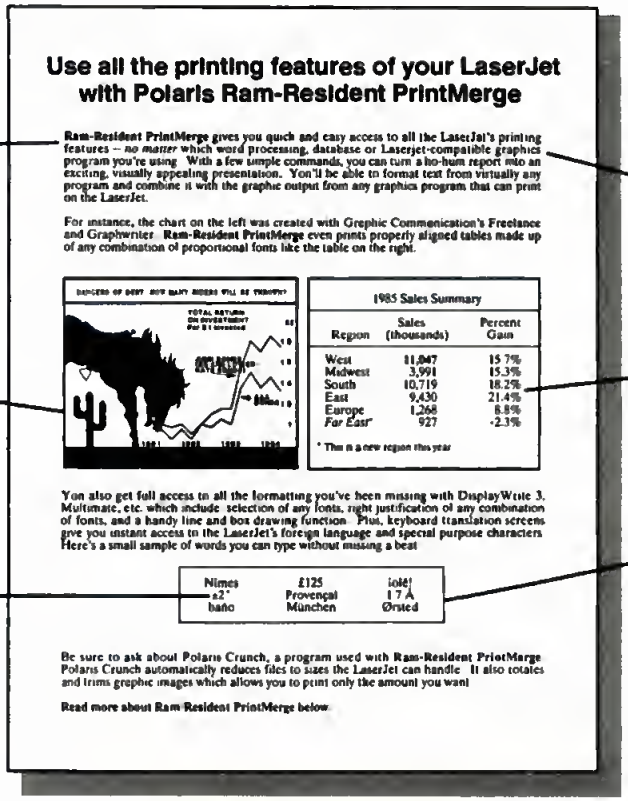

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Since Ram-Resident PrintMerge lets you merge graphics from virtually any program that prints on the LaserJet, you can reinforce complex ideas with illustrations right in the text. You can merge the graphic output or save a screen image, and merge either in any of four print resolutions. If your graphics are too large for your LaserJet to handle, try Polaris Crunch, a separate program that compresses, rotates and trims images.

Recommended by HEWLETT PACKARD

With the help of Ram-Resident PrintMerge's useful formatting features, your document will be as impressive as its contents. You'll be able to use LaserJet fonts in any combination for more attractive, readable text. And justify right-hand margins and align table columns printed with proportional fonts—even if they're downloaded from diskettes. For extra emphasis, use Ram-Resident PrintMerge's line and box drawing capabilities and the LaserJet PLUS patterns to highlight important ideas.

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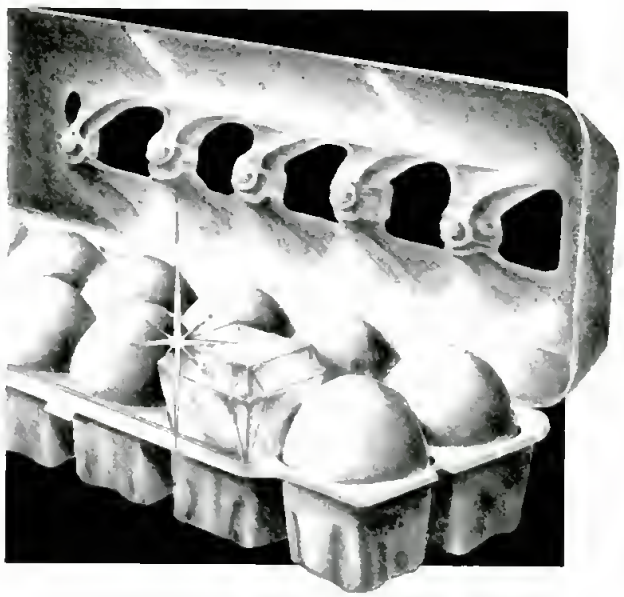

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With a name that belies its thoroughness, Brief™ has every feature you've ever contemplated for your editor in-chief. Text from keyboard or files is housed in multiple buffers, and scrolled through one or more windows you open, close, resize. A text buffer may be called to different windows to view two areas at once. A change in one changes both. Text blocks may be marked for printing, writing to files, movement to scrap buffers for cut and paste into other buffers, or deletion, with as many "undo" levels as you want.

Brief has text search abilities rivaling "grep" with wildcards for matching, indifference to intervening characters, acceptance of character ranges.

If you use Lattice, C86™, or Wizard, and have 320k, you can compile your C program without ever leaving Brief. It finds the lines with errors, and marches you through the text for repairs.

Parts of Brief were written with its own Lisp-like macro language which has structure, 32-character variable names, conditional execution, loops, and you can actually read it! Nothing like the hieroglyphs we've seen elsewhere. Bulletin board and public domain disks with macros. "Simply the best text editor you can buy" Dvorak *Infoworld* (Needs 192k.)

| Ask for | List | PC Brand |
|---|---|---|
| U0590 | $195 | **Call** |

## HALO GRAPHICS SYSTEM *Multi-Board Graphics Library*

The premier graphics library that got the ball rolling for PC-based graphics and has grown so omnipotent that it supports over 25 graphics boards — including IBM's EGA and Nr. 9 Revolution's hi-res series — and has a multitude of mouse and printer drivers. All that in each box. Separate C versions for Lattice, M'soft, Aztec, CI86. What does Multi-Halo do? A down to the last pixel graphics library plus functions to reset drivers so distributed program can run on anything. Wonderful value for single license. Flexible licensing available for redistribution. Specify S0315 & Language. List $300. We $219. With Dr. Halo II, a free-standing "paint". List $440, Us $299.

## WINDOWS for C/WINDOWS for DATA *Microsoft Windows™ and TopView™ Compatible*

**CALL FOR FREE DEMO!**

Windows for C™ is a library of over 80 functions to add the pizazz and practicality of window partitioning to your application. Unlimited windows, each defined in a C structure for easy reference throughout your program, can be made either to pop up or permanently overwrite the screen. Routines will scroll and highlight lists with arrow keys, will read and scroll ASCII files vertically and horizontally in windows, and even write to memory-loaded files off the screen.

Logical treatment of video attributes permits unchanged programs to run on color or monochrome. Colors of windows are set individually.

All functions are in separate modules, only those used are linked. Only buffers holding on-screen or temporarily obscured windows occupy RAM; others released dynamically. Best overall rating and fastest display in Bill Hunt's 7/85 *Tech Journal* review of five windowing products.

**Windows for Data** comprises all of Windows for C but takes in data through the windows as well. At the high level a single function lets you specify prompt string, field length, data type, screen location, picture, target variable, then sets lesser functions scurrying to get and process a user's input. There are utilities to get system date and time, mess with strings, create your own masks for fields.

Field options can require entry, prevent entry, permit insert or overtype, beeping on invalid or overflow keystrokes, and attachment of field-specific help messages and functions you want called to display messages or validate entries. And you decide which keys will clear a field, jump to the next or prior, quit, etc. Options diverse enough that a set of "fields" can be made to behave like a Lotus™ menu.

| Specify | Compiler | List | PC Brand |
|---|---|---|---|
| T0100 | Windows for C | $195 | $149 |
| T0150 | Windows for Data | $295 | $259 |

## MICROSOFT C 4.0 *A Great C Battle Rages and You're Winning*

As the dreadnaughts pound each other with ever heavier ordnance, today's programmers reap the spoils of this war. Bundling a source debugger and a "make" and sporting a "huge" memory model permitting single data objects larger than 64k, the Microsoft C compiler has jumped a full version number to 4.0. But what's really impressive are the benchmarks reported in Dr. Dobb's (8/86) encyclopaedic survey of 17 C compilers. Microsoft's and IBM's C (licensed from Microsoft) run away with the contest winning 11 of 27 benchmarks.

The CodeView™ debugger, free for a limited time, uses windows to show everything on one screen: source alongside disassembled object, variables, stack and registers. Drop down windows—use a mouse if you like—obviate learning of commands. "A source-level debugger that puts the rest to shame" (Dobb's).

Microsoft C now has five memory models for code and data, plus non-library support for another thirteen, and boasts alternate math packages for speed versus accuracy, with or without 8087/80287 chips. A big plus in multi-language settings: call from this C any routine written in later versions of M'soft Pascal, FORTRAN, or Macro Assembler. Object code of all four may be intermixed come link time or commingled into libraries.

Both linker and library manager are part of the package, as is the "make", a UNIX™ name for a smart batch program which knows to expend minimum effort to rebuild any size of project by compiling and assembling only elements affected by new or changed modules.

It is reportedly used by Lotus, Ashton-Tate and, fittingly, Microsoft itself to develop Windows. Dobb's calls it "the best MS-DOS C development environment value today [for] virtually any kind of program conceivable" 320k suggested.

| Ask for | List | PC Brand |
|---|---|---|
| C0500 | $450 | $295 |

## C-TREE *B-Tree File Manager, Source Code, No Royalties!*

C-tree is sturdy code that has weathered many seasons of prolonged and widespread use. It comes in C source, so you can modify it to fit a special case. No royalties provided you bind it into your binary application.

C-tree's design splits nodes to allow any number of users to access an index file simultaneously even when updates are in progress. So multi-user configurations and adaptation to networks are possible. Record-locking routines are provided for DOS 3.1/3.2, UNIX and XENIX.

Thanks to source code which does not deviate from the K&R standard, C-tree can travel. Tests in many environments prove that C-tree gives your application a ticket to anywhere.

C-tree permits any number of keys for a data file, supports duplicate keys, alphanumeric or numeric, supports files of variable record length, multiple keys in one index file, and keys of variable length. Both high level ISAM routines which handle details with minimum coding, and decomposed step-by-step functions you can access directly. It's comprehensive.

| Ask for | List | PC Brand |
|---|---|---|
| F0660 | $395 | $329 |

## CURSES *Unix Style Screen Management*

Curses from Lattice™ manages the screen of the PC like Unix™ curses. Library of 84 functions and macros parallels Unix with matching parameter lists. So Unix programs are at home on the PC, and vice versa. Keeps any number of screens in memory, supports color, vast function set to get characters, wrap lines, scroll, blank lines, highlight, etc. Like Unix refreshes screen only on your command. Ask for L0850. List $125. Here $99. With Source L0860, $250/$199.

## dBC *Lattice Library Maintains dBASE Compatible Files With the Power and Speed of C*

dBC™ links C to dBASE. It creates and maintains files and their indexes which exactly replicate dBASE file design. So dBASE can read and update them. And the reverse: dBC can use any files created by dBASE. Now C and dBASE can operate on the same data bases interchangeably.

That opens up the widespread culture of dBASE installations to exploitation by C programmers. Tap that market, avoid the resident dBASE language, and gain the advantages of C with this single product.

dBC's functions parallel all dBASE's file handling commands, many decomposed to give closer control. Each backed by demo source files on disk.

Use dBC for custom work for clients, or on its own. It's a complete ISAM file manager for C whether or not dBASE will be used in tandem, supports all four memory models, and can have sixteen index and data files open. Big discount to buyers of both dBASE II and III versions. Specify Lattice, Microsoft 3.x, or DeSmet.

| Versions. | | List | PC Brand |
|---|---|---|---|
| L00II | For dBASE II | $250 | $195 |
| LCCII | With Source | $500 | $390 |
| L0III | For dBASE III | $250 | $195 |
| LCIII | With Source | $500 | $390 |

## PANEL *Feature-Laden Screen Design Tool*

Writing your own screenware can blow completion dates and profits. Panel™ works with you interactively to set up foolproof screen displays and data entry forms rapidly. Output is C source code.

Not just single plane, layer your screen designs with up to ten overlapping images. Background pop-up lists, help boxes, and alternate input fields.

Panel builds in a user interface for keystroke movement within and between fields, supplies validation routines for checking user field entries. Diverse attributes may be selected for any field — size, data type, color, conversion of input to upper case, clearance of existing data when new entry is started, masks for standard formats (eg, dates), phrases which fill in when their first letter is typed, multiple-choice lists from which to choose by cursoring a highlighted bar. Fields may be multi-lined and scrolled if larger than the screen space allotted them. Specify S0400 & Compiler. List $295. Us $229.

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## GREENLEAF *Bountiful Harvest* FUNCTIONS

C source, assembler source, and binary libranes of 225 functions for many compilers. Emphasizes tight functional groupings to minimize loading code which your application may never use. Manual helps select functions, bulletin board, too.

A sampling: *DOS* extensions for file and directory manipulation; *Screen*: to select mode, page, monochrome or color, palette, cursor shape, positioning; clearing and scrolling, pixel get and put, read light pen. *Strings*: Center, justify, etc., efficient list operations which add, delete, sort string pointers for top speed. *Other*: graphics character primitives, keyboard status, function key assignment, time/date, read registers and memory size, peek and poke. Mature best-seller. Specify: S0770 & Compiler. List $185. Here $139

## PFORCE *Phoenix Pfunction Pfestival*

Lotus® didn't do badly pulling it all together in one place. Phoenix has followed suit with the ultimate integrated C library, offering everything from low level functions for hardware access to complete b-tree database management. Along the way are prerequisites such as string manipulation, time/date, field and screen editing, but also four styles of menus (Lotus included), windowing, background tasking, DOS interfaces, directory management, even interrupt-driven communications. Design emphasizes objects, so characteristics of windows, databases, records and fields can be initiated and changed outside functions.

One large collection in place of bits and pieces means one set of instructions and PforCe™ has tutorials, extensive examples, quick reference, and on-line help.

Everything in source, no royalties, all memory models of Lattice, M'soft. Specify: S0220 & Compiler. List $475, PCB $349

## GREENLEAF *Hello World* COMMUNICATIONS

Want your application to communicate with other users or remote date bases by asynchronous communications built right into your C programs! Even if you don't need it now, that's a skill to have at the ready!

120 functions *and demo programs in both C and assembler source code* set up separate transmit and receive ring buffers for up to 16 simultaneous channels. Interrupt driven so you can halt an incoming record, display it, file it, let the user edit it, then continue. Goodbye separate communications software.

Supports up to 9600 baud, ASCII or binary, any parity or word length, 8250 UARTs, Xon/Xoff and Xmodem, WideTrack receive. Specify: S0750 & Compiler. List $185, Us $139

PRICE SLASHED!

## PRE-C *Pick the Lint from Your Program*

Pre-C is like UNIXs lint. It finds problems your compiler won't. Problems that a debugger will have trouble figuring out. Even problems which will cause trouble with other compilers.

Compilers see one module at a time. Modules only meet at link time. Pre-C looks at *all modules at once* and reports conflicts in data type declarations, function call parameters which disagree with functions, machine-dependent expressions which inhibit portability. It spots obsolete usage (even C changes) casts with suspect conversions, variables never used, functions never called, unreachable code. Adheres to UNIX System III compile standard to ensure your portability. Ask for P0590, List $295, Ours $208

## DAN BRICKLIN'S DEMO PROGRAM *Storyboard Your Program*

The Legendary One has created Metaphor Two when the rest of us are still on Zero. Dan's first was the original electronic spreadsheet (VisiCalc™). This one is for programmers.

Words don't express program ideas because programs are screens! Dan's Demo creates slide shows. Create a screen — a snapshot of your planned product as it runs. Anything goes: words, borders, box rules, inverse and underlining of monochrome, fore- and background color. Copy this "slide" to an empty screen. Change it a little, to show the next instant of run-time. Do it again. Presto, a whole slide show of your program in action.

All 250 characters and attributes are available from scrollable lists which pop to the screen. All commands are layered in Lotus-style pop-up menus. Frequent choices mapped to function keys as well.

80x25 character mode, not bit-mapped.

Screen areas can be blocked for cut and paste or filled with color or characters, even blink. Slides can overlay on others, can be shuffled, deleted. Slides can proceed at time intervals or branch anywhere in the slide sequence depending on user keyhits.

Invaluable to prototype the program you are about to write, to position the labels, choose the color decor, smoothe out the keystroke interface. Or load the "capture" utility and snapshot the screens of any running program for an instant slide show.

Each copy entitles you to redistribute fifty of the slide projector program that runs demos. Plain manual, no binder keeps price of big product small. "Might become *the* essential tool in ... user interface prototyping," *Tech Journal*. Ask for N0100. List $75 US $69

## BASTOC OPTIMIZES! *Translates BASIC Into C*

For a trifling price, BASTOC™ moves truckloads of BASIC code over to C. It's a translator which takes in Microsoft Extended BASIC and emits pure K&R C for Lattice 3.0. It will optionally convert your program into a single monolithic C function or decompose it into separate functions, one for each GOSUB label.

Version 2's optimization dramatically reduces execution time. Converts to integers those variables in BASIC programs which do not need floating point. Where BASIC uses full assignment statements to increment counters, BASTOC converts to C's compact form. Strings dynamically allocated, ridding your application of BASIC's catatonic halts for garbage collection. Creates structure of even convoluted BASIC code. Huge worksaver.

| Ask for | List | PC Brand: |
|---|---|---|
| S0375 | $495 | $399 |

## Shopping List for the Power Workbench

| | LIST | OURS |
|---|---|---|
| **ASSEMBLERS & DEBUGGERS** | | |
| **Advanced Trace-86** *Morgan, ASM Interpreter* | 175 | 149 |
| **Codesmith-86** *Debugger by Visual Age* | 145 | 109 |
| **Cdebugger** *by Micro-Software Developers* | 165 | 139 |
| **CSD Debugger** *C source level by Mark Williams* | 75 | 75 |
| **C-Sprite Debugger** *by Lattice, source level* | 175 | 139 |
| **Microsoft Macro Assembler** *with Utilities* | 150 | 109 |
| **PASM86** *by Phoenix, Macro Assembler* | 195 | 144 |
| **Periscope I Debugger** *Data Base Decisions* | 295 | 269 |
| **Periscope II** *Data Base Decisions* | 129 | 111 |
| **Pfix86 Plus** *by Phoenix, Symbolic Debugger* | 395 | 279 |
| **BASIC LANGUAGE** | | |
| **BetterBASIC** *Summit Software* | 195 | 165 |
| **BetterBASIC Utilities** *8087 Math Support* | 99 | 85 |
| *Btrieve Interface* | 99 | 85 |
| *Run-Time Module* | 250 | 225 |
| **Microsoft BASIC Interpreter** *for XENIX* | 350 | 295 |
| **Microsoft QuickBASIC Compiler** *full BASICA* | 99 | 79 |
| **Professional BASIC** *by Morgan* | 99 | 79 |
| **RM/BASIC** *by Ryan-McFarland* | 600 | 480 |
| **True BASIC** *True BASIC Inc* | 150 | 119 |
| *Run Time Module (Price slashed)* | 150 | 119 |
| **True BASIC Libraries** *Btrieve, Asyn, Sort, etc.* | Var | Call |
| **C COMPILERS** | | |
| **C-86 Compiler** *Computer Innovations* | 395 | 289 |
| **Lattice C Compiler** *from Lattice* | 500 | 299 |
| **Let's C Compiler** *by Mark Williams* | 75 | 69 |
| *with CSD Source Level Debugger* | 150 | 129 |
| **MWC-86: Mark Williams C Development** | 495 | 369 |
| **Microsoft C Compiler** *4.0* | 450 | 295 |
| **C INTERPRETERS** | | |
| **C-Terp** *by Gimpel Software* | 300 | 249 |
| **Instant C** *by Rational Systems* | 500 | 395 |
| **Interactive-C** *by IMPACC with debugging* | 249 | 219 |
| **RUN/C Professional** *from Lifeboat* | 250 | 185 |
| **RUN/C** *without Loadable Libraries* | 120 | 109 |
| **TEXT EDITORS** | | |
| **Brief** *from Solution Systems* | 195 | Call |
| **Epsilon** *by Lugaru Software, like EMACS* | 195 | 169 |
| **FirsTime** *by Spruce Technology, C syntax* | 295 | 229 |
| **Kedit** *by Mansfield, similar to Xedit* | 125 | 115 |
| **LSE, the Lattice Screen Editor** *Multi Window* | 125 | 100 |
| **Pmate** *by Phoenix, with Macros* | 195 | 149 |
| **Text Management Utilities** *Grep, splat, diff, etc.* | 120 | 100 |
| **Vedit** *by Compuview* | 150 | 119 |
| **Vedit Plus** *by Compuview* | 225 | 180 |
| **FILE MANAGERS** | | |
| **Btrieve** *by Softcraft, no royalties* | 250 | 195 |
| **Btrieve Network** *by Softcraft* | 595 | 465 |
| **c-tree** *by FairCom — no royalties, source* | 395 | 329 |
| **dBC** *dBASE file manager from Lattice* | 250 | 195 |
| *with source* | 500 | 390 |
| **dbVista** *single user DBMS by Raima* | 195 | 159 |
| **dbVista** *multi-user DBMS* | 495 | 429 |
| **Opt-Tech Sort** *Can sort Btrieve files* | 149 | 119 |
| **SCREEN MANAGEMENT & DESIGN** | | |
| **Curses** *by Lattice, UNIX screen designer* | 125 | 99 |
| *with Source* | 250 | 199 |
| **Greenleaf DataWindows** *New* | 225 | 169 |
| *with Source simultaneously* | 395 | 297 |
| *Source purchased later* | 225 | 169 |
| **On-Line Help** *from Opt-Tech Data* | 149 | 119 |
| **Panel** *by Roundhill, no royalties* | 295 | 229 |
| **View Manager for C** *by Blaise* | 275 | 209 |
| **Vitamin C** *by Creative Programming* | 150 | 139 |
| **Windows for C** *Vermont Creative Software* | 195 | 149 |
| **Windows for Data** *includes Windows for C* | 295 | 259 |
| **ZView** *Data Management Consultants* | 245 | 199 |

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| **GRAPHICS** | | |
| **Essential Graphics** *by Essential, no royalties* | 250 | 210 |
| **GSS Graphics Development Toolkit** | 495 | 375 |
| **GSS Kernel System** *by Graphic Software* | 495 | 375 |
| **GSS Kernel System** *for IBM RT* | 795 | 645 |
| **GSS Metafile Interpreter** | 295 | 235 |
| **GSS Plotting System** | 495 | 375 |
| **Halo Graphics Kernel System** | 300 | 219 |
| *with Dr. Halo II, by Media Cybernetics* | 440 | 299 |
| **COMMUNICATIONS** | | |
| **Asynch Manager** *by Blaise, for C or Pascal* | 175 | 149 |
| **Greenleaf Communications** *by Greenleaf* | 185 | 139 |
| **PTel** *by Phoenix, Binary File Communicator* | 195 | 149 |
| **Software Horizons Pack 3** | 149 | 119 |
| **UTILITY LIBRARIES** | | |
| **Blaise C Tools Plus** | 175 | 149 |
| **Blaise C Tools** | 125 | 109 |
| **Blaise C Tools 2** | 100 | 89 |
| **C Food Smorgasbord** *by Lattice* | 150 | 109 |
| **C Utility Library** *by Essential, 300 functions* | 185 | 139 |
| **Greenleaf Functions** *by Greenleaf Software* | 185 | 139 |
| **PforCe** *by Phoenix, vast library* | 475 | 349 |
| **Software Horizons** *Packages* | Var | Call |
| **TopView Tool Basket** *by Lattice, source avail* | 250 | 199 |
| **DEVELOPMENT TOOLS** | | |
| **Code Sifter** *by David Smith Software, Profiler* | 119 | 89 |
| **C-Worthy** *by Custom Design Software* | 295 | 269 |
| **C-Worthy for Network** *Menus, help, errors* | 495 | 449 |
| **Dan Bricklin's Demo Program** *Prototyper* | 75 | 69 |
| **LMK from Lattice** *by Lattice, "make" like UNIX* | 195 | 149 |
| **Microsoft Window Development Toolkit** | 500 | 365 |
| **PC-Lint** *by Gimpel Software, after UNIX's "lint"* | 139 | 125 |
| **PFinish** *by Phoenix, EXE performance analyzer* | 395 | 279 |
| **Plink86 Plus** *Utilizes memory for overlays* | 495 | 359 |
| **Pmaker** *by Phoenix, like UNIX "make"* | 125 | 105 |
| **Pre-C** *by Phoenix, UNIX "lint"-alike* | 295 | 209 |
| **Plantasy Pac** *six Phoenix products* | 1295 | 995 |
| **OTHER TOOLS** | | |
| **BASTOC** *by JMI, convert BASIC to C* | 495 | 399 |
| **BASIC-C** *BASIC's functions added to C* | 175 | 139 |
| **The HAMMER** *by DES Systems* | 195 | 179 |
| **Report Option** *by Softcraft, Btrieve Report Gen* | 145 | 129 |
| **Xtrieve** *by Softcraft, Query Utility for Btrieve* | 245 | 220 |
| **FORTRAN COMPILERS & UTILITIES** | | |
| **ACS Time Series** *by Alpha Computer Service* | 495 | 469 |
| **Forlib- Plus** *by Alpha Computer Service* | 70 | 59 |
| **Microsoft FORTRAN** *Links with Microsoft C* | 350 | 219 |
| **Microsoft FORTRAN** *for XENIX* | 695 | 546 |
| **Pro FORTRAN** *by Prospero* | 390 | 345 |
| **RM/FORTRAN** *by Ryan-McFarland* | 595 | Call |
| **Scientific Subroutine Library** *by Peerless* | 175 | 149 |
| **Scientific Subroutine Package** *by Alpha* | 295 | 269 |
| **The Statistician** *by Alpha Computer* | 295 | 269 |
| **Strings & Things** *by Alpha Computer* | 70 | 59 |
| **OTHER LANGUAGES & UTILITIES** | | |
| **Microsoft COBOL Compiler** | 700 | 499 |
| **Microsoft COBOL Compiler** *for XENIX* | 995 | 795 |
| **Microsoft COBOL Tools** *with Source Debugger* | 350 | 259 |
| **Microsoft COBOL Tools** *for XENIX* | 450 | 333 |
| **Microsoft Lisp** *New Common Lisp* | 250 | 189 |
| **Microsoft MuMath** *Includes MuSimp* | 300 | 199 |
| **Microsoft Pascal Compiler** *Links with M'soft C* | 300 | 199 |
| **Microsoft Pascal Compiler** *for XENIX* | 695 | 546 |
| **Pro Pascal** *by Prospero, ISD Validated* | 390 | 345 |
| **RM/COBOL** *by Ryan-McFarland* | 950 | 675 |
| **RM/COBOL 85** *ANSI 85 CDBDL* | 1250 | 995 |
| **Source Print** *Aldebaran's diagrammer* | 139 | 109 |

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## RYAN-McFARLAND FORTRAN

### *A Mighty Fortress Is Their FORTRAN*

NEW!

Picking over features of rival products is not necessary if FORTRAN is your need, still the citadel of scientific and engineering work. Ryan-McFarland has left the competition battering at the gates.

RM/FORTRAN™ is a complete implementation of FORTRAN-77 (ANSI X3.9-1978), the only PC FORTRAN certified by the General Services Administration at the highest test level. The reason: it's a big mainframe compiler moved to PCs, with the bonus that mainframe and mini applications can wander between environments.

Now, on your PC, you can develop large applications, with programs up to 640k (bigger using overlays), arrays over 64k, and using a long list of VS, VAX and FORTRAN-66 extensions you may have grown fond of — long symbolic names, "include", IRT bit functions — because R-M has left out nothing.

But what really sets RM/FORTRAN apart is optimization. The compiler reduces the number of instructions to the minimum which will actually execute, and even takes advantage of each processor's features to deliver lightning-fast object code. It runs 30%-40% faster than Microsoft 3.2, and could make your mainframe not worth the trouble.

Comes with an interactive symbolic debugger like that accompanying IBM VS FORTRAN, Plink86 subset, has a cross reference compile option, supports assembler and C subroutine calls, IEEE floating point, 8087 and 80287 chips.

"Compiler's documentation, ease of use, speed of execution, and debugger facilities place it first for recommendation" said the *Tech Journal* (10/85).

R-M has been writing FORTRAN compilers for IBM, DEC, etc. for 20 years. There is no greater expert.

| Ask for | List | PC Brand |
|---|---|---|
| I0300 | $595 | **Call** |

## RUN/C PRO

### *C Interpreter Links Binary Libraries*

Run/C comes in an apprentice and pro version. The professional model dynamically loads and unloads multiple binary function libraries like C-Food Smorgasbord™ and Halo Graphics™ — potentially any library compiled with Lattice's large model. Inside this interpreter your C program can reach for functions in the best of commercial libraries.

This C interpreter behaves like PC BASIC meets WordStar®. Use fullscreen editing to create a program, RUN it. If it stumbles, LIST it, EDIT it, RUN it again, fix it again. Use familiar commands like LOAD, MERGE, SAVE, FILES, even TRON and TRACE.

Ideal for program development. Put up code at high speed, try out things devil-may care, let RUN/C find your malaprops. Blast away until tight little code segments are undyingly faithful.

Lots more features: system interrupts, a shell command to invoke any operating system command without leaving Run/C, debugging aids ingeniously installed as a Run/C function. Call for debugging conditionally from within your program, a specific function or a menu of aids including immediate mode, single-step tracing, changing of variable values.

Manual shows how to develop the interface to a commercial library, using the Lattice compiler (a must!). Link your own function archive the same way. (320k minimum, 512k recommended to fit libraries.)

Ask for S0950. List $250. PCB $185.

## PLINK86 PLUS

### *Cached Overlays Maximize Memory Use*

Long the overlord of overlay linkers, Plink86 shoehorns large programs into small machines by swapping program segments in from disk to save memory. A 512k program could run in a 128k machine, for example. But Plink86 Plus is smarter still: if it finds itself in a larger machine, it moves program overlays into leftover memory. Overlays now swap at memory speed not disk speed. Can automatically restore a displaced overlay to which a subsequently called overlay must now return, and assign library modules to the root segment or overlay areas. Plink86-Plus: List $495. Us $359.

## LATTICE C COMPILER

### *Major Upgrades to the Best Selling C Compiler*

Lattice now embraces key UNIX™ enhancements which have entered the language since K&R: void functions returning no value, enumerated data types to assign stepped values to variables, data passing between structures by assignment.

The greatly expanded libraries (325 functions!) enable the file sharing and record locking provisions of DOS 3.1, provide a full complement of transcendentals, and a host of utilities to mimic the UNIX and XENIX™ environments.

Lattice 3.0 defaults to the ANSI proposed standard when you need strict adherence, but command line options restore leniency. And it adopts ANSI checking of external function arguments by data type to kill bug swarms when modules join up at link time.

Lattice now delivers smaller .EXE files, boasts very fast link times and a more efficient aliasing algorithm. New options generate code to use 80186 and 80286 features, 8087 of course sensed and utilized. Lattice has enjoyed pre-eminence so long that developers have created far more snap-on tools for Lattice C than any other compiler. William Hunt's *PC Tech Journal* review of 12 compilers awarded Lattice the only "very good" rating for add-on library availability.

| Ask for | List | PC Brand |
|---|---|---|
| S0100 | $500 | $299 |

### FOREIGN POLICY

**We ship anywhere.** Phone or Telex your order. Credit cards: We need card number, expiry date, name and address of card. Or wire funds to PC BRAND, c/o Chemical Bank, 126 East 86th St., NY NY 10028, Account No. 034-016058. **We'll ship immediately** and confirm by Telex if you provide number.

## BETTER BASIC

### *Convert Microsoft BASIC. Structured, Compilable.*

Combines the familiarity of BASIC with the best features of C, Pascal, and Modula 2, yet BetterBASIC is 100% compatible with Microsoft's GW™ BASIC and IBM BASICA including graphics, sound, and assembly language calls. So load your old programs and RUN, SAVE and they are converted automatically to BetterBASIC!

It's big. Needs 192k, programs can go to the PC's full 640k. It's comfy. Behaves like M'soft BASIC at the interactive level, with a full-screen editor, direct statement execution, and always poised to RUN. It's fast. Each statement checked and compiled once, not every time encountered. Sieve runs *6 times faster* than with M'soft.

C-like structures house file records so goodbye to FIELD, MKI$, CVD, LSET, etc. Named "procedures" replace GOSUBs to linenumbers. Lots more features: built-in linker for compiled modules, trace, debugging breakpoints, cross-reference command, 32k strings, DOS and BIOS calls and interrupts; recursion. Run-time module stores object code for redistribution.

| Ask for | List | Us |
|---|---|---|
| S1200 BetterBASIC | $195 | $165 |
| S1201 Run-time Module | $250 | $225 |
| S1202 8087 Interface | $ 99 | $ 85 |
| S1205 Btrieve Interface | $ 99 | $ 85 |

## GSS GRAPHICS SYSTEM

### *Leave the Device Driving to GSS*

ANSI CGI STANDARD! PRICES CUT!

GSS™ has reconfigured two components of its comprehensive graphics tools to conform with the ANSI Computer Graphics Interface (CGI) standard.

At the heart of the system is the Development Toolkit which contains all language interfaces and device drivers for keyboards, mice, joysticks, tablets, printers, plotters, cameras, and more. Drivers house management of vector graphics (plotters) and bitmaps used by raster input devices (scanners) to insulate the application program from concern for device idiosyncracy. No one else has implemented CGI that way. It means your programming remains generic; just switch drivers and the same program will drive a different device.

GSS Kernel™ conforms to level 2b of ANSI's Graphical Kernel System (GKS) and contains all its needed drivers and language bindings. Kernel has macro level tools to draw and color an object, store the sequential instructions, and recreate the object on its own, as well as segment it, transform it, etc. So powerful, a single command may represent several score lower level statements.

Plotting has the equivalent GKS tools for graph and chart generation and their captioning: hand it apples and oranges, say "pie", and it bakes the numbers into a digestible display for screen or plotters.

Kernel and Plotting have tools to convert images they create to ANSI Computer Graphics Metafiles (CGMs), a tokenized standard for storing every form of graphic image as data. The Metafile Interpreter reads the contents of a CGM and interprets it with full CGI capability for re-creation on various devices.

Quality software? IBM thinks so. They sell the GSS series under their own label.

Unit royalties and annual fees have been instituted for redistribution. Needs 256k.

| Ask for: | List | PC Brand |
|---|---|---|
| GS010 CGI Dvlpmt Toolkit | $495 | $375 |
| GS020 Kernel System | $495 | $375 |
| GS025 Kernel for IBM RT | $795 | $645 |
| GS030 Plotting System | $495 | $375 |
| GS040 Metafile Interpreter | $295 | $235 |

## BTRIEVE

ASK ABOUT XTRIEVE & RTRIEVE

### *Queen B-tree File Manager Abdicates Royalties*

There's no longer a tithe to incorporate Btrieve™ in applications, a welcome proclamation if royalties would ruin your profit margins. Btrieve takes complete charge of all file creation, indexing, reading, writing, insertion, deletion, space recapture, forward and backward searching. It builds function call "commands" right into the language you use: interfaces to C, Pascal, BASIC, and COBOL, with sample programs in all four, come with each copy.

Btrieve has mainframe specifications! Its balanced-tree indexing scheme finds any key in a million in four or less accesses. Files may have up to 24 indexes, fixed record length to 4090 characters, indexes up to 255 characters; files of 4 billion bytes. Can even extend a file across two drives — even two hard disks!

Version 4.x speeds DOS interaction for large multiply-keyed files, enables variable length records of virtually any length, verifies accuracy (optionally) with read after write, useful in gritty environments, offers password and data encryption.

There's also Xtrieve, for Btrieve file inquiry and data manipulation, and Rtrieve for report writing. All three in versions for any network that supports the MS-DOS 3.1 file sharing function.

| Ask for | List | PC Brand |
|---|---|---|
| S0650 | $250 | $195 |
| S0652 Network Version | $595 | $465 |

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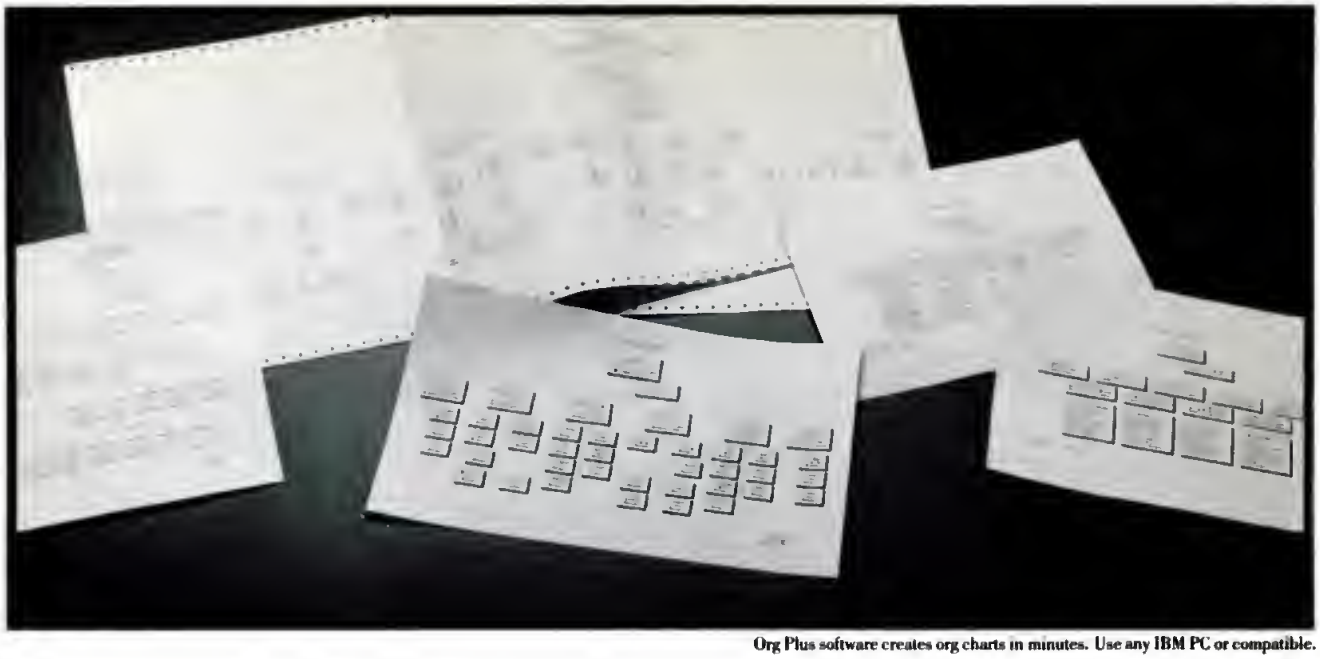

Org Plus software creates org charts in minutes. Use any IBM PC or compatible.

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By the way, Org Plus is designed so you don't need a secretary or an art department to do your charts. But, it can make their job easier, too.

## Rave reviews

"The charts are perfectly laid out and attractive."—Glenn Hart, *PC Magazine* 2/25/86

"The program is so simple to use that you'll find little use for either the manual or the on-line help screens."—Henry F. Beechhold, *Computer Consultant* 6/86

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Reviewers' comments are based on version 1A of the program. Org Plus works on an IBM PC/XT/AT or 100% compatible computer with 256 Kb of RAM. DOS version 2.0 or higher and a printer or HP plotter are required. Org Plus is not copy protected. A 70 page User's Guide and telephone support are included. Registered owners will receive upgrade information.

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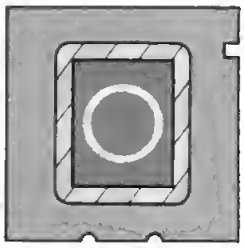
■ GUS VENDITTO



# PC ADVISOR

*Help for readers in deciding whether to buy a 3½-inch microfloppy disk drive and in buying the right system to use with desktop publishing software.*

**EASY ACCESS TO 3½-INCH DISKS**

I'm thinking of buying a 3½-inch disk drive for my IBM PC. Some people have told me that it plugs into the floppy controller, while others said it needs a new board. I've also heard that it costs about $300 to $350, in which case I would get a hard disk drive instead. Please tell me more about the 3½-inch drive.

Eric Hsiao
Poughkeepsie, New York

*Sounds like you're a forward-thinking fella, but I have to wonder if maybe you're getting ahead of yourself on this. It's a good bet that the PC community will one day embrace the 720-megabyte, 3½-inch microfloppy disk as the diskette standard, but for now, these disks are simply a nuisance for those who must shuttle data between laptop and desktop PCs. The extra 360K bytes you get per disk may make the microfloppy drives seem a better buy over a 20-meg hard disk, but the real benefit of the hard disk is convenience: your data is always accessible. Get a hard disk before you buy a 3½-inch drive.*

*When you're ready to adapt your data to the future standard, there are a few choices. IBM's external 3½-inch drive is $395 and available only for ATs and late-model XTs; it needs no controller, as it connects to a serial port in the AT, XT, or Convertible. IBM's internal drives are $190; late-model XTs and ATs can use a drive that hitches up to a serial port. Earlier PCs need a different model (for the same price), which has its own controller.*

*Toshiba's ND354A fits in a floppy bay and runs off the floppy controller (Tustin, Calif., (714) 730-5000, $150).*

*Of course, laptop owners may never need such a drive: modem and null modem transmissions can keep files fluid.*

**DESKTOP PUBLISHING SYSTEMS**

Our promotions department is buying an IBM PC and *WordStar* software very soon. We're also looking toward the day when we may purchase a desktop publishing system for our graphics department.

Are there any recommendations you can make for the PC we're purchasing now that may make it compatible with desktop publishing programs later on?

I realize that Macintosh is the top of the line for desktop publishing now, but all of the computers in our station are IBMs. I'd find it difficult to justify a system that would not be compatible with those units.

Karen Rugg
Binghamton, New York

■ It's a good bet that the PC community will one day embrace the 3½-inch microfloppy disk, but for now these disks are simply a nuisance.

*Our recommendation: buy an IBM PC AT or compatible now and sit tight. We've seen several programs that are now in the late stages of development that will truly change the face of desktop publishing on the PC. They'll be ready by early 1987 and will require the speed and power of a 286-based machine to perform the calculations needed for sophisticated layouts; you'll also need a laser printer to get top-quality output. These programs will do everything you can now do on a Macintosh and a lot more.* WordStar *is a good choice; any word processor that can produce ASCII text will be fine. EGA graphics are a must, unless you're willing to pay for over-sized, high-resolution screens ($2,395 for a 19-inch Moniterm screen, (612) 935-4151; or $1,795 for a 15-inch Genius display, (612) 437-2233).*

*If you need a good program for producing leaflets and simple brochures now, try* ClickArt Personal Publisher *(Software Publishing, Mountain View, Calif.; $195) or* The Newsroom *(Springboard Software, Minneapolis, Minn.; $59.95). But if you can wait a few months more, can invest in a laser printer, and are willing to spend the $700 to $900 that the new programs will cost (and possibly the extra cost of buying* Microsoft Windows*; some will run only in that environment), you'll soon be able to create some amazing page layouts with your AT.*

**ASK THE ADVISOR**

Send your questions to the PC Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016. PC

# Softline PRICE BUSTERS

| Lotus 1-2-3 | Paradox | dBase III Plus | FrameWork II | Multimate Advantage | Word Perfect 4.1 |
|---|---|---|---|---|---|
| $319 | $469 | $389 | $389 | $279 | $209 |

## Software

### Word Processing

| | |
|---|---|
| FANCY FONT | $139 |
| FINAL WORD II | $218 |
| MICROSOFT WORD 3.0 | $279 |
| MULTIMATE | $249 |
| MULTIMATE ADVANTAGE | $279 |
| OFFICE WRITER/ SPELLER | $239 |
| PFS: WRITE | $ 89 |
| SAMNA WORD III | $279 |
| THINK TANK | $109 |
| TURBO LIGHTNING | $ 85 |
| VOLKSWRITER 3 | $159 |
| VOLKSWRITER SCIENTIFIC | $259 |
| WORD PERFECT 4.1 | $209 |
| WORDSTAR 2000 | $249 |
| WORDSTAR 2000 + | $289 |
| WORDSTAR PRO | $259 |
| XYWRITE III | $199 |

### Database Systems

| | |
|---|---|
| CLIPPER | $359 |
| CONDOR III | $339 |
| DBASE III PLUS | $399 |
| KMAN 2 | $339 |
| PARADOX | $469 |
| PFS: FILE/ REPORT | $159 |
| Q&A | $249 |
| QUICKCODE III | $158 |
| QUICKREPORT | $159 |
| R BASE SYSTEM V | $359 |
| REFLEX | $ 69 |
| REVELATION | $499 |

### Spreadsheets/ Integrated Packages

| | |
|---|---|
| ENABLE | $349 |
| FRAMEWORK II | $389 |
| JAVELIN | $419 |
| LOTUS 1 2-3 | $319 |
| MULTIPLAN | $135 |
| OPEN ACCESS II | $299 |
| SMART SYSTEM | $439 |
| SPREADSHEET AUDITOR | $ 99 |
| SUPERCALC 4 | $289 |
| SYMPHONY | $449 |
| TWIN | $ 79 |

### Graphics

| | |
|---|---|
| CHARTMASTER | $219 |
| DIAGRAPH | $309 |
| DIAGRAM MASTER | $199 |
| ENERGRAPHICS 2.0 | $299 |
| FREELANCE | $209 |
| GEM DRAW | $149 |
| GRAPHWRITER COMBO | $309 |
| IN A VISION | $259 |
| MAPMASTER | $239 |
| MS CHART | $199 |
| PC DRAW | $209 |
| PC PAINTBRUSH | $ 99 |
| PFS: GRAPH | $ 99 |
| PICTURE PERFECT | $245 |
| SIGNMASTER | $149 |
| WINDOWS/DRAW | $119 |

### Project Management

| | |
|---|---|
| HARVARD TOTAL PROJECT MANAGER | $279 |
| MICROSOFT PROJECT | $249 |
| PROJECT SCHEDULER NETWORK | $339 |
| SUPERPROJECT + | $289 |
| TIMELINE 2 0 | $239 |

### Communications Productivity Tools

| | |
|---|---|
| CARBON COPY | $ 129 |
| CROSSTALK | $ 99 |
| PROKEY | $ 85 |
| RELAY GOLD | $ 149 |
| REMOTE | $ 109 |
| SMARTERM | $Call |
| SMARTCOM II | $ 99 |
| SUPERKEY | $ 55 |

### Statistics

| | |
|---|---|
| SPSS/PC + | $899 |
| STATGRAPHICS | $449 |
| STATPAC GOLD- WALONICK | $399 |
| SYSTAT—NEW | $499 |

### Accounting

| | |
|---|---|
| BPI | $309 |
| GREAT PLAINS | $479 |
| IUS EASYBUSINESS | $309 |
| ONE WRITE PLUS | $159 |
| OPEN SYSTEMS | $409 |
| REAL WORLD | $399 |
| STAR ACCOUNTING PARTNER II | $529 |

### Network Applications

| | |
|---|---|
| DBASE III LAN PAK | $999 |
| KMAN 2 | $899 |
| MULTIMATE | $839 |
| MULTIMATE ADVANTAGE | $749 |
| OPEN SYSTEMS | $459 |
| RBASE 5000 | $799 |
| REVELATION | $999 |
| SAMNA WORD III | $799 |
| WORD PERFECT SERVER | $309 |
| WORD PERFECT STATION | $ 75 |

### Language Utilities

| | |
|---|---|
| C86 C COMPILER | $ 319 |
| COPYWRITE | $ 45 |
| FASTBACK | $ 99 |
| LATTICE C | $ 259 |
| MICROSOFT C COMPILER | $ 289 |
| MS BASIC COMPILER | $ 249 |
| MS FORTRAN | $ 229 |
| NORTON UTILITIES | $ 59 |
| QUICK BASIC | $ 89 |
| TURBO PASCAL | $ 89 |
| TURBO PROLOG | $ 69 |
| XENIX | $Call |
| ZERO DISK | $ 70 |

### Desktop Environments

| | |
|---|---|
| DESQVIEW | $89 |
| GEM DESKTOP | $39 |
| MS WINDOWS | $69 |
| SIDEKICK | $49 |

## Hardware*

### Multifunction Boards

| | |
|---|---|
| AST ADVANTAGE (128K) | $349 |
| AST 6 PAK PLUS (64K) | $199 |
| AST I/O MINI | $139 |
| AST MP MINI | |
| AST PREMIUM PAK (512K) | $359 |
| AST RAMPAOE PC | $249 |
| AST RAMPAOE AT | $459 |
| AST SHORTRAM (0K) | $159 |
| INTEL ABOVEBOARD PS AT | $399 |
| JRAM AT-3 (0K) | $239 |
| JRAM 3 (0K) | $179 |
| ORCHID CONQUEST (0K) | 9279 |
| ORCHID ECCEL (0K) | $399 |
| PC TURBO 286 (1MB) | $799 |
| PC TINY TURBO 286 | $459 |
| QUADBOARD (64K) | $139 |

### Display Boards

| | |
|---|---|
| HERCULES GRAPHICS CARD | $199 |
| HERCULES COLOR CARD | $159 |
| PARADISE MODULAR GRAPHICS | $259 |
| QUADRAM EGA + | $389 |
| SIGMA COLOR 400 | $449 |
| STB EGA PLUS | $299 |
| TECMAR EGA MASTER | $299 |
| TSENG ULTRA PAK | $429 |
| TSENG EVA-CM II | $379 |
| TSENG EVA 480 | $Call |

### Emulation Boards

| | |
|---|---|
| AST 5211-11 + | $649 |
| AST 52S1-12 | $499 |
| AST BSC | $489 |
| AST SNA | $599 |
| IRMA | $725 |
| SMART ALEC 5251 | $699 |

### Modems

| | |
|---|---|
| AST REACH 1200 | $359 |
| HAYES 1200 | $399 |
| HAYES 1200B | $349 |
| HAYES 2400 | $579 |
| HAYES 2400B | $549 |
| TRANSNET 1000 | $279 |
| VENTEL 1200 HALF CARD | $389 |
| VENTEL 1200 PLUS | $299 |
| WATSON | $339 |

### Mass Storage/Backup

| | |
|---|---|
| IOMEOA 10 + 10 W/INTFC | $1999 |
| IOMEGA 20 + 20 W/INTFC | $2599 |
| IRWIN 120D 20MB TBU | $ 599 |
| IRWIN 145AT 40MB TBU | $ 999 |
| MOUNTAIN ORIVECARD 20MB | $ 719 |
| PLUS HAROCARO 10MB | $ 569 |
| PLUS HARDCARD 20MB | $ 719 |
| PRIAM 42MB AT | $949 |
| SYSGEN SMART IMAGE 20MB (INT) | $ 925 |
| TALLORASS | $ Call |
| TECMAR OIC-60AT TBU (INT) | $1199 |

### Monitors

| | |
|---|---|
| AMDEK 310A | $159 |
| AMDEK 600/722 | $429/$39 |
| NEC MULTISYNC | $819 |
| PRINCETON HX-12 | $449 |
| PRINCETON MAX-12E | $179 |
| PRINCETON SR-12 | $499 |
| PRINCETON HX-12E | $539 |
| PRINCETON HX-9 | $529 |
| TAXAN 122 AMBER | $159 |
| TAXAN 630/840 | $469/539 |

### Networks

| | |
|---|---|
| AST PC NET | $Call |
| NOVELL | $Call |
| ORCHID PC NET | $Call |

### Printers/Plotters

| | |
|---|---|
| BROTHER TWINWRITER | $ 939 |
| DATA PRODUCTS | $Call |
| DIABLO 935 | $1149 |
| EPSON FX-86 | $ 399 |
| EPSON FX-286 | $ 579 |
| EPSON LQ-800 | $ 589 |
| EPSON LQ-1000 | $ 789 |
| HP 7475A | $ Call |
| NEC 3550 | $ 799 |
| OKIDATA 192 | $ 379 |
| OKIDATA 193 | $ 819 |
| OKIDATA 292 | $ 539 |
| OKIDATA 293 | $ 689 |
| TOSHIBA P321 | $ 499 |
| TOSHIBA P341 | $ 929 |
| TOSHIBA P351 | $1069 |

### Input Devices

| | |
|---|---|
| KEYTRONICS 5151 | $189 |
| KEYTRONICS 5153 | $299 |
| MICROSOFT MOUSE | $129 |
| PC MOUSE W PAINT + | $139 |

### Accessories

| | |
|---|---|
| CURTIS SUROE PROTECTORS | $Call |
| DATASHIELD BACKUP POWER | $Call |
| OATASHIELO SUROE PROTECTORS | $Call |
| GILTRONIX SWITCHES | $Call |
| MASTERPIECE PLUS | $ 135 |
| MICROFAZER INLINE BUFFERS | $Call |
| 256K RAM SET | $ 39 |
| 8087 MATH CHIP | $ 119 |
| 80287 MATH CHIP | $ 189 |

*CALL FOR SHIPPING COSTS

| NEC Multisync | Mountain Drivecard 20 | Quadram EGA+ | Hayes 1200B Halfcard | JRAM AT-3 | IRMA Board |
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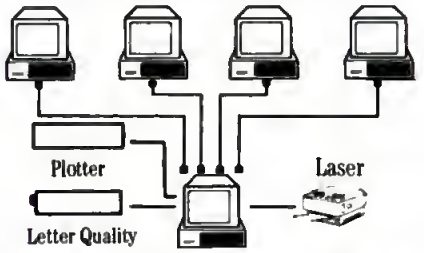


***EasyPRINT*—Printer Sharing System**

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**CIRCLE 147 ON READER SERVICE CARD**

At the heart of the personal computer publishing movement is a set of skills almost unknown to anyone outside the typesetting trade. A unique lexicon of terms describes the methods used to arrange letters on a page in an eye-pleasing manner. The typographer's language contains terms dating back to Gutenberg's time.

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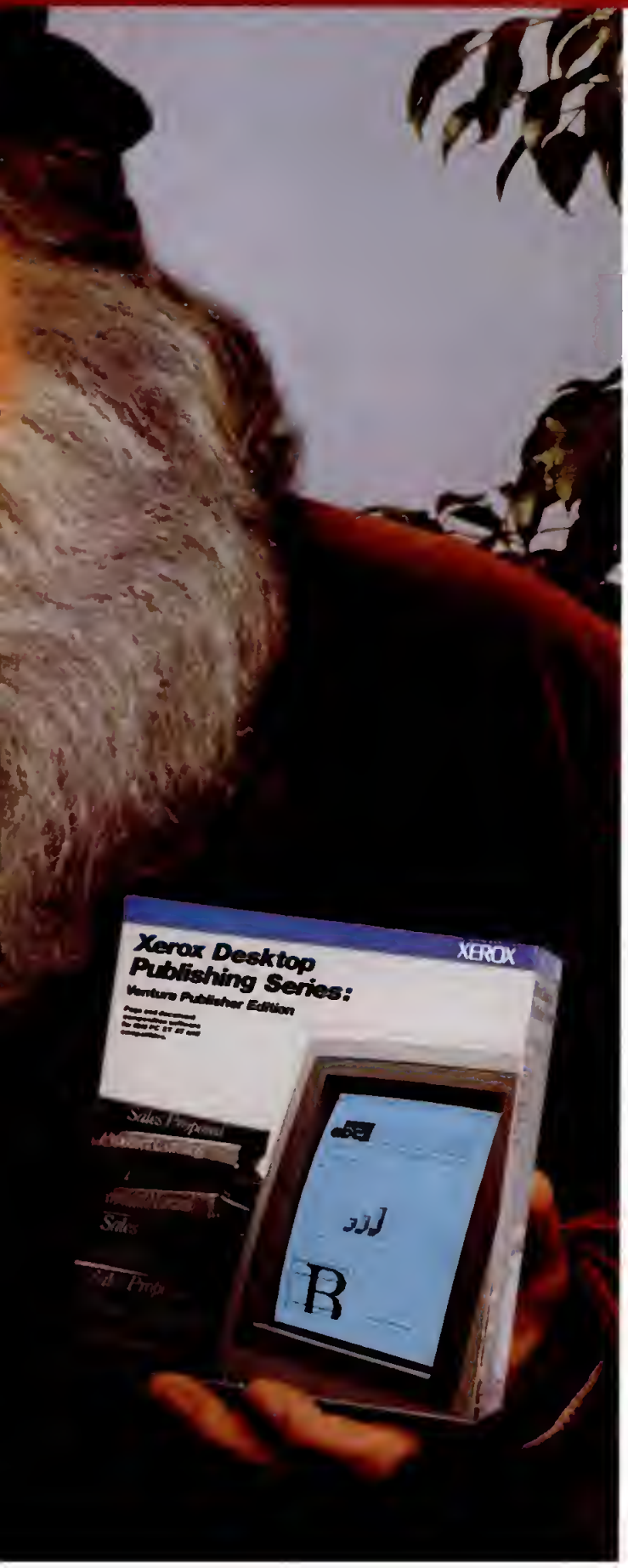
A standard measure for open space is the **em**, named for the width of the M, which is usually the widest letter in a typeface's character set. The size of an em is always equal to the current point size. When you're setting a line in 12 point type, an em is 12 points wide.

Related to the em is the **en**, which is equal to half the width of an em or the width of the letter N. The **thin space**, is a user-definable unit, usually half an en. Typographers adjust the space between letters to improve readability. The process, called **kerning**, is determined by the shapes of the adjacent letters. In electronic *publishing*, typographic attributes are imposed by embedding codes within unformatted text. A hyphenation and justification program then interprets the codes and makes the line-ending decisions.

Because the letter blocks were originally made out of lead alloy, the vertical space between lines of type

Figure 11 The art of typography is now combined with the power of the PC.

XEROX

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CIRCLE 276 ON READER SERVICE CARD

Hauppauge

PC MAGAZINE FIRST LOOKS

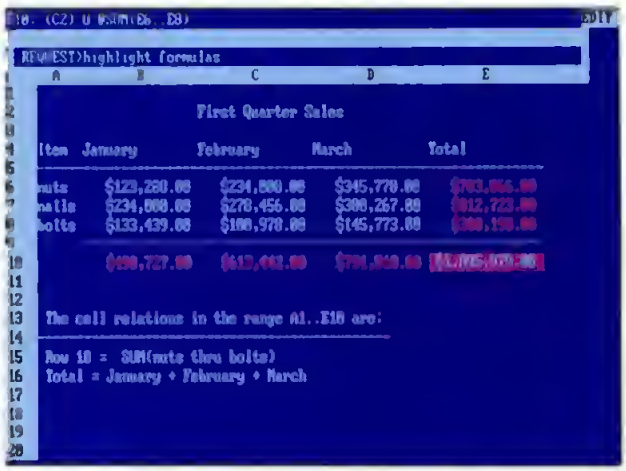
# 1-2-3 Magic: HAL Makes Spreadsheets Intelligent

PC HANDS ON

BY CHRISTOPHER BARR

Remember in the movie *2001: A Space Odyssey* how HAL, the talking computer, took control of the spaceship? Seemed a little farfetched? The future has arrived: *HAL* exists, and although this *HAL* doesn't speak English, it does understand it.

*HAL* is the latest and second-greatest invention to come from Lotus Development Corp. A *1-2-3*-only companion product, *HAL* lets you use English-language commands to run *1-2-3* (Release 1A or 2). In addition, this memory-resident program allows you to do things never before possible, such as link spreadsheets and, finally, undo your last command, even if it was /Worksheet Erase.




*The* HAL *request box sits on top of the worksheet in place of the familiar* 1-2-3 *command menu. Here,* HAL *lists the cell dependencies and highlights the formulas.*

*HAL*'s best use is in analyzing large worksheets and manipulating fields of massive data. It's so easy to use, though, that just about every *1-2-3* chore can benefit from *HAL*.

Consider the creation of a simple worksheet. Copy *HAL* into your *1-2-3* subdirectory (it's not copy protected), and at the C> prompt type HAL. *HAL* will load itself and then load *1-2-3*. Soon you are greeted by the familiar inverted "L" and

*(continued on next page)*

# DESQview 1.3: First True Extended Memory for the 386

PC HANDS ON

BY CHARLES PETZOLD

*DESQview*, Version 1.3, from Quarterdeck Office Systems is the first available "80386 control program" that runs existing DOS applications in the virtual 8086 mode of the 80386 microprocessor. Virtual 8086 mode allows a much cleaner and more efficient approach to multitasking than has previously been available (see sidebar, "The Evolution from the 8088 to the 80386's Protected Mode," on page 35).

Although you can use *DESQview*, Version 1.3, on a PC, XT, or AT, it will look and act much the same as Version 1.2 (see review in "Operating in a New Environment", *PC Magazine*, Volume 5 Number 4). When run on the Compaq Deskpro 386, however, Version 1.3 allows existing DOS programs to run in both conventional and extended memory. This gives you the ability to simultaneously run several large DOS applications without bank-switched memory and without hitting the normal 640K-byte DOS memory ceiling.

## Virtual 8086 Mode

The virtual 8086 mode that makes this possible is only available on the 80386 microprocessor. Although Version 1.3 uses virtual 8086 mode only when run on a Compaq Deskpro 386, Quarterdeck will be adding support of other 80386 machines and boards.

Virtual 8086 mode takes advantage of extended memory beyond the normal 1-megabyte addressing space. This extended memory is *not* bank-switched Lotus/Intel/Microsoft expanded memory or

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## HAL

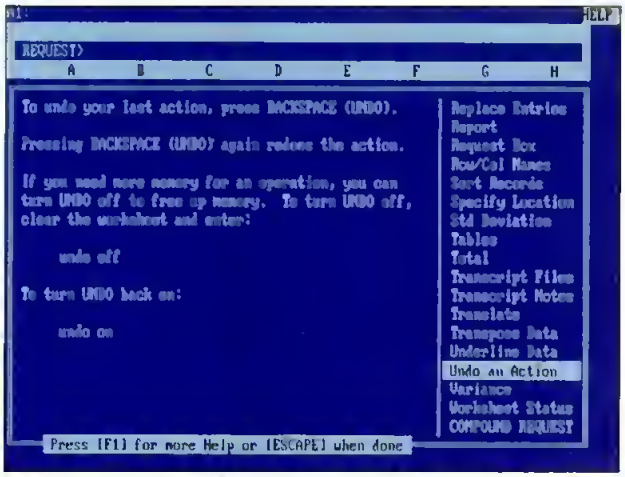
*(continued from preceding page)*

an indicator at the bottom of the screen showing that *HAL* is available. Press the Backslash key and the *HAL* request box appears on top of the worksheet, replacing the *1-2-3* command menu. Commands can now be typed into the request area.

### Creates Formulas

Type "\enter january to december across in C3", and *HAL* will insert January in C3, February in D3, and so on. If you had requested "\enter january to december in C3" and not used the qualifier across, the months would be entered vertically, starting in C3 and going down to C15. If you make a mistake, press the Backspace key and your last command is reversed.

Similar *HAL* commands will enter the rest of your spreadsheet's data. Now, type "\total all columns", and *HAL* will put a line under the last row and enter the totals below. If you move the cell pointer to the total in column C, you can see that *HAL* created the formula @SUM(C4..C6). When you type "\graph this", *HAL* automatically enters the totals into a bar graph and displays it—of course, you could have requested a stacked-bar, line, or pie graph. Yes, it's that easy.




*F1 opens* HAL*'s context-sensitive help facility. You can write your own help screens to explain synonyms that you have added to* HAL*'s commands.*

*HAL* alters *1-2-3*'s function-key assignments slightly. F1 continues to be context-sensitive help, but if the request box is enabled, it activates *HAL* help screens. F3 and F4 are used to scroll backward and forward through the requests you have made during the session. You can see how *1-2-3* would process a command by pressing F6 after you type the command but before you press Enter.

If you press F6 after you typed "\graph this" in the example above, you can see that it takes *1-2-3* over 60 keystrokes to define ranges and draw the graph. F7, usually the query key, is used to start, name, or end a transcript file. The transcript file is an ASCII text file in which all of your keystrokes are recorded.

### Easier Audits

If the Undo option alone isn't enough of a reason to make you run out and buy this jewel, Lotus built in a number of analysis features that all allow you to easily audit a worksheet. With *HAL* you can highlight or list formulas, highlight or list dependents (the cells that are affected if a cell value is altered), and highlight or list precedents (feeder cells that affect the target cell).

*HAL* can also list cell relations, making it possible to check formula relationships for accuracy—an invaluable tool for locating mistakes in large spreadsheets.

Until now, multidimensionality, or the ability to cross-link spreadsheets with *1-2-3*, was only a pipe dream. *HAL* allows you to link two or more files as long as they are in the same subdirectory. For example, suppose you are working on a worksheet titled ATLSALES and the total in cell H22 feeds into cell B30 in another file called TOTSALES. To make a link you would type "\link h22 to b30 in TOTSALES." Save ATLSALES and when you next retrieve TOTSALES, *HAL* looks for links and updates the file.

### Learns New Words

You can personalize *HAL* by entering your own synonyms to replace the command words. Say you want to end a session; *HAL* recognizes four different words to do this: bye, exit, quit, and leave. You can impart your own style to *HAL* as simply as calling the SYN__US.PRN file and adding "adios = quit" or "ciao = quit" or even "later = quit" to the list of synonyms. More than one synonym file is possible but together they can't be more than 64K bytes. Help files can be similarly customized.

The biggest difference between using *HAL* with *1-2-3* and using *1-2-3* alone is ease of use. If you are new to *1-2-3*, *HAL* will get you up to speed in no time. If you are an intermediate *1-2-3* user, *HAL* will make you a power user. Power users will appreciate *HAL*'s compatibility with the *1-2-3* macro language and the help it provides for debugging. As HAL said in *2001*, "Look, you've got a lot of things to do. I suggest you leave this to me."

PC MAGAZINE FACT FILE

***HAL***
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
**List Price:** $150
**Requires:** 512K RAM, *1-2-3* (Release 1A, 2, or 2.01), DOS 2.0 or later.
**In Short:** A RAM-resident program that uses English-language commands to operate *1-2-3*. *HAL* introduces unprecedented features to *1-2-3*, including an Undo option and the ability to link spreadsheets. Not copy protected.

CIRCLE 447 ON READER SERVICE CARD

## Is HAL Really an Upgrade To 1-2-3 Posing as an Add-On?

*HAL* is a terrific product. It is silly for a serious user of *1-2-3* not to buy a copy. But unless Lotus Development Corp. starts bundling *HAL* with *1-2-3*, the extra $150 makes *1-2-3* one of the most expensive spreadsheets on the market.

The introduction of *HAL* may be only the beginning of a new Lotus marketing strategy. Add-on products such as *HAL* and Turner Hall Publishing's *Note-it* and *SQZ!* are by their very nature actually ideas turned into "patches" to improve the original (*1-2-3*). It seems as though all these ideas posing as products should be included in an inclusive and major upgrade to *1-2-3*.

The introduction of *HAL* as an add-on, instead of an integral part of an upgrade, may be a signal not to expect any more upgrades of *1-2-3*. Every future upgrade will be an expensive patch.

Surely people will not complain about Lotus's expensive upgrade policies with this strategy.

Take it or leave it.

Lotus's *1-2-3* is now the first software package that has an immediate $150 upgrade available. If Lotus follows this concept to its logical extreme, we can expect to see dozens of future upgrades sold as expensive add-ons. A copy of a fully upgraded *1-2-3* could cost $1,500 or more after all these patches are purchased.

*—John C. Dvorak*

## DESQview

(continued from page 33)

AST/Quadram/Ashton-Tate enhanced expanded memory. This is the extended memory that until now has been unavailable to DOS applications for anything beyond a RAMdisk or print spooler.

When installing Version 1.3 on a Compaq Deskpro 386, you don't need to do much beyond the normal *DESQview* installation procedure. The difference will come when you load up several applications that in total require more than 640K bytes of RAM. Instead of swapping some applications to disk, Version 1.3 will continue to run them all. The new memory limit is the total amount of conventional and extended memory installed in the machine.

Right now, however, *DESQview*, Version 1.3, is disappointing because it just scratches the surface of the virtual 8086 mode.

Under the virtual 8086 mode of the 80386, however, a control program can map the display memory of each virtual 8086 session to a different location in memory. It could then transfer portions of this memory to windowed areas of the real display memory. This (and other abilities of virtual 8086 mode) allows real multitasking among applications that cannot be multitasked on the 8086 and the 80286.

Version 1.3 does not do this. It will not, in general, multitask among applications that write directly to the display. However, *DESQview* still will window some popular applications. This technique basically involves dynamically patching the programs to route display output elsewhere. This should not be necessary with virtual 8086 mode.

In theory, an 80386 control program can also protect the rest of the system from a crash that may occur in a single virtual 8086 session. Such protection becomes more and more important in a multitasking environment as the amount of memory available to run concurrent applications increases. Currently, Version 1.3 is doing only a minimal amount of this sort of protection.

### On to the Future

Quarterdeck intends to make fuller use of virtual 8086 mode in the future, so *DESQview* buyers are advised to mail in their registration cards to guarantee that they stay current.

Although *DESQview*, Version 1.3, is the first program to tap virtual 8086 mode for multitasking existing DOS applications, being the first is no longer a guarantee of success. It is also necessary to do it right. Quarterdeck now has some more work to do. PC

### PC MAGAZINE FACT FILE

***DESQview*, Version 1.3**
**Quarterdeck Office Systems**
**150 Pico Blvd.**
**Santa Monica, CA 90405**
**(213) 392-9701**
**List Price:** $99.95
**Requires:** 512K RAM, two disk drives, DOS 2.0 or later.
**In Short:** Notable as the first program that uses the virtual 8086 mode of the 80386 microprocessor for multitasking. However, more-extensive use of the power of the virtual 8086 mode will be necessary to prevent this distinction from becoming just a footnote. Not copy protected.

CIRCLE 448 ON READER SERVICE CARD

## The Evolution from the 8088 To the 80386's Protected Mode

The Intel 80286 microprocessor used in the PC AT and compatibles is capable of running in either real mode or protected mode. Real mode emulates the first generation of microprocessors in the PC family: the 8086 and 8088 (the 8088 is an adaptation of the 8086 for use in the 8-bit bus IBM selected for the PC and PC-XT). When operating in real mode, the 80286 has the same 1-megabyte memory limit as the 8086 and 8088.

When switched into protected mode, the 80286 can address 16 megabytes of memory. In addition, protected mode includes hardware support for multitasking and (as the name implies) protection of tasks and the operating system from malfunctioning software that would otherwise cause a system crash.

Current versions of DOS support only real mode. Taking full advantage of protected mode requires a more complex and sophisticated operating system. A version of DOS that supports protected mode is expected from Microsoft sometime in 1987. However, this protected-mode DOS will have only a limited ability to run existing DOS programs. The real value of protected-mode DOS will come with a new generation of software written specifically for this new environment.

Due to the problems of running existing programs in protected mode, the transition from current DOS to protected-mode DOS will be difficult.

The 80386 microprocessor supports both real mode and protected mode. In protected mode, the 80386 can address 4 gigabytes (4 billion bytes) of memory rather than the 16 megabytes (16 million bytes) addressed by the 80286.

Also, the 80386 microprocessor provides a third mode, called the virtual 8086 mode. Virtual 8086 mode is a middle ground between real mode and protected mode. It is part of protected mode but with blocks of memory defined to mimic the 8086 addressing space. Many virtual 8086 sessions can occupy various areas of the entire 4-gigabyte memory space. A control program could isolate and multitask several existing applications by placing each in its own virtual 8086 session with its own copy of DOS.

An operating system or control program written for the 80386 controls the mapping of memory accesses from these virtual 8086 sessions to actual memory. Thus memory accesses involving the display memory can be mapped somewhere else. An 80386 control program can also intercept anything from these virtual 8086 sessions that may affect the system as a whole (such as hardware interrupts or I/O port manipulation).

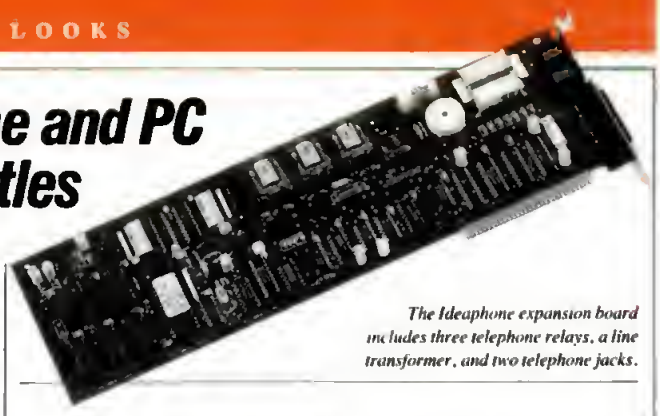
Virtual 8086 mode is actually more valuable under a protected-mode operating system, since it provides an ability to run current DOS programs along with new protected-mode programs.

The release of an 80386 control program before the availability of an 80286 protected-mode DOS is discomforting news for AT owners, particularly those who have been waiting over 2 years to get at the AT's potential 16 megabytes of memory. While AT owners can calmly accept the greater speed and address space of the 80386 (since that type of improvement is normal for an evolving line of microprocessors), virtual 8086 mode seems like something that should have been included in the 80286.

That would have been nice, but it hasn't happened. In the long run, protected mode will replace real mode, virtual 8086 mode will become irrelevant, and we'll all be better off. In the interim, however, the virtual 8086 mode provides a convenient way to multitask existing applications that is simply not available on the 80286.

*—Charles Petzold*

# Ideaphone Integrates Phone and PC Without the Bells and Whistles



*The Ideaphone expansion board includes three telephone relays, a line transformer, and two telephone jacks.*

PC HANDS ON

BY FRANK J. DERFLER, JR.

Ideatech's Ideaphone is a card/software package that brings telephone functions into the PC. Ideatech included some useful and unique features, but it also kept the bells and whistles to a minimum, designing a system that's economical and flexible but not intrusive.

Aimed at heavy users of both the PC and the telephone—like telemarketers, stockbrokers, and order-entry applications clerks—the Ideaphone's emphasis is not on arriving at a completely seamless integration between the telephone and the PC, but on creating a useful base system with built-in programming hooks and hardware features that will integrate with applications software.

The Ideaphone consists of a full-length circuit board that has two telephone jacks and a parallel port. You can use your own headset; alternatively, you can buy either a $50 Plantronics Spirit II headset or a $60 Panasonic speakerphone from Ideatech.

## RAM-Resident Software

The Ideaphone software is RAM-resident, which makes excellent sense since telephone use literally does interrupt every other activity. Ideaphone's system takes up about 30K bytes of RAM and, like seemingly all RAM-resident software, comes with instructions to "load this program last." I've never figured out how to load every program last, but nonetheless have found this software well behaved enough to run with *SideKick* and *ProKey*, no matter in which order they were loaded.

Several features in the software offer good ties into applications programs. The software can read any phone number on the screen. You can either place the cursor on the first digit and tell the program to read the number, or you can have the program always read numbers from the same location on the screen. This means you can use a simple RAM-resident word processing program to create a list of numbers (*SideKick*'s Notepad, for example), or you can put code into a DBMS applications program to have it write a phone number to a specific screen location.

The Ideaphone's dual-tone multifrequency (DTMF) decoding option listens for tones being entered by a caller, decodes them, and sends the results to a specific memory location. An applications program can read the results and use them for a variety of functions, such as passwords, data entry, or remote control.

The manual for the Ideaphone lists data and command addresses used by the telephone control software. A chart details the hexadecimal codes that will cause specific actions; these addresses and commands can be used to give an applications program complete control of the Ideaphone system. You can also construct a completely automatic answering system for remote data entry by writing an application that shares information with the Ideaphone software.

## Telephone Features

The Ideaphone contains several useful telephone features. It lets you place a call on hold, flash the receiver switch (to get the attention of a Private Branch Exchange), and redial numbers. The system sends a short repeating beep to let a person on hold know that he is still connected. It will also remind you when a line has been on hold for a specified period of time.

In addition, you can instruct the phone to ignore a certain number of rings so that your

(continued on page 43)

## The Fate of Computerphones

Nineteen eighty-five was to have been the year of the Integrated Voice Data Terminal (IVDT). In 1984 and 1985, companies such as Zaisan, Rolm, and Compaq unveiled PCs specially modified to allow integration with telephone features.

Other companies, such as CoSystems and Asher Communications, along with Rolm released add-on products that brought telephone functions into the PC. ITT came out with one of the most sophisticated of these devices, which combined voice synthesis and capture with telephone functions—but the company's marketing effort was virtually nil. And IBM later joined the parade with the IBM PC Voice Communications Options package.

While sales have not yet matched the hopes of those who have invested heavily in this technology, the continuing arrival of new products demonstrates that you can't keep a good idea down. It just makes sense to integrate telephone and computer functions—at least for people who spend the greater part of their working day operating both instruments.

*—Frank J. Derfler, Jr.*

*The Ideaphone's RAM-resident software reflects the product's simplicity: redial, hook flash, and hold are called by function keys. Little else is needed.*

PC MAGAZINE FACT FILE

**Ideaphone**
Ideatech Inc.
1806 T St NW
Washington, DC 20009
(800) 247-IDEA
(202) 667-4559
**List Price:** Ideaphone, $295; Plantronics Spirit II Headset, $50; Panasonic Easa-Phone, $60; DTMF decoder, $45.
**In Short:** Add-in card integrating basic phone functions with a PC

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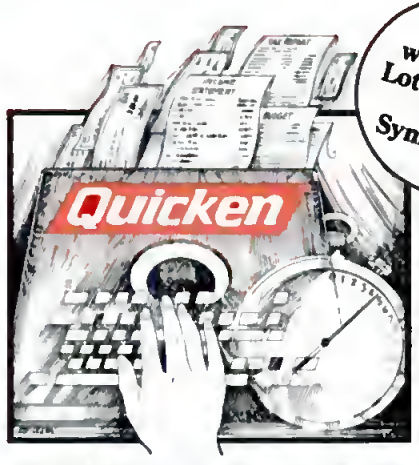


AFTER QUICKEN: Finally, automate your finances with software so fast and so automatic that time and hassles evaporate.

Also works with Lotus® 1-2-3® and Symphony™

## CRITICS HAIL A BREAKTHROUGH

—InfoWorld Review Board

**"It's more than good—it's indispensable. Home and small business checking software used to be too expensive, too hard to use, and too rigid, and it took too long to use. Quicken has changed all that."**

—Ken Landis, A+ Magazine

**"Thanks to Quicken, I'm automating my personal checking account. I've never seen such an easy-to-use manual or software that's so simple to use."**

—Martin Blumenthal, InCider Magazine

**"Now there is a program that truly saves time when it comes to paying bills and keeping track of tax-deductible items, and that program is Quicken."**

—Parents Magazine

**"Extremely simple and fast."**

—Esther Dyson, Release 1.0

If you write checks, you need Quicken®—the breakthrough software that automates financial management for business and home.

**The breakthrough is Quicken's fully automatic design.** Quicken is so automatic it remembers your recurring bills and pays them—all you do is sign the checks. Automatic macros cut laborious data entry down to two keystrokes. Quicken manages your checkbooks and even finds and fixes your mistakes. It tracks and totals your expenses by date, payee, and category.

Quicken is so completely automatic it remembers to save and backup your data, even if you forget!

And if you use 1-2-3 or Symphony, Quicken will automatically fill in your spreadsheets with your financial data!

**Quicken does the paperwork for you.** It's bill-paying time. Fire up Quicken and the screen looks just like a check. Your first bill is the bank loan, you press two keys and, zap, Quicken's macros write out the full check. Next, the American Express bill. It's a biggee. You're glad Quicken knows exactly how much cash you have. Macros write the check, letting you pick how much to pay. You slip paper checks in the printer. Don't bother positioning them, Quicken does that for you.* Sign the printed checks and slip them into Quicken's window envelopes ...you're done.

**Recordkeeping? That's done for you.** With each bill, Quicken filled out your records, updated all balances, and saved it all on disk. Need to record a check you wrote at the store? No problem, Quicken's macros update your records in an instant.

Expense tracking, tax reporting, budgeting? Simple. Say you want to know your charity spending. Ask Quicken, and you get an itemized list and dollar total. You'll always know exactly where your money is going. Want spending for Job 104 or Account 3072? The answers are just keystrokes away.

**Need cost reports, P&L's or other financial reports?** Set up the spreadsheet you want in Lotus** 1-2-3 or Symphony. Quicken's ingenious Spreadsheet Transfer actually reads your spreadsheet and fills in the numbers you want, where you want them.

Dread reconciling the checkbook? Quicken makes it simple. And you can't go wrong: If there's a mistake, Quicken will pinpoint the error and automatically correct for it!

**Vastly faster and simpler than old-style finance software.** Quicken is the first financial software that's truly simple. No accounting mumbo-jumbo (no "debits," no "parameters"), no setup hassle.

The first finance software that's truly fast. Not just 10% or 20% faster, it's 200% to 300% faster than old-style finance software.

The first finance software that's tested, approved, and recommended by leading banks across the U.S.

**For every business and home**—for professionals, for small businesses, for non-profit organizations, for computer experts and total novices. Quicken handles an unlimited number of transactions and accounts.

Personalized checks for your printer are available for any financial institution in the U.S. or Canada. Free samples and order form are in every Quicken package.

**At $49, Quicken pays for itself right away for anyone who values their time.** Quicken is a price breakthrough, too. Never has so much cost so little.

Compatibility:

IBM® PC, XT, AT, PCjr., and compatibles with 192K RAM and one or two floppy disk drives or hard disk. Any printer. No modem required. 1-2-3 and Symphony optional.

Apple® IIgs, IIc and IIe (IIe requires extended 80-column card), with one or two floppy disk drives, or UniDisk™ 3.5. Any printer. No modem required. AppleWorks optional.

Quicken is a trademark of Intuit. Apple, UniDisk and AppleWorks are trademarks of Apple Computer, Inc. IBM is a trademark of IBM Corp. Lotus 1-2-3 and Symphony are trademarks of Lotus Development Corporation.

*Patent Pending **Lotus Transfer Utility available for $15 from Intuit

Quicken

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30 DAY RISK FREE TRIAL: If not completely satisfied, return within 30 days for refund.

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CIRCLE 307 ON READER SERVICE CARD

# TDebugPlus: Don't Program In Turbo Pascal Without It

PC HANDS ON

BY NEIL J. RUBENKING

TurboPower Software has recently moved to Scotts Valley, Calif., home of Borland International. That's not surprising since all of the company's products so far have been utilities for Borland's Turbo Pascal: Turbo users have broken the "64K barrier" with *TURBO Extender*, tracked down program errors with the *Program Structure Analyzer*, and measured execution speed with the *Program Execution Timer*. Now they can interactively debug Turbo programs with *TDebugPlus*.

*TDebugPlus* is a true source-code debugger. Features include the ability to:

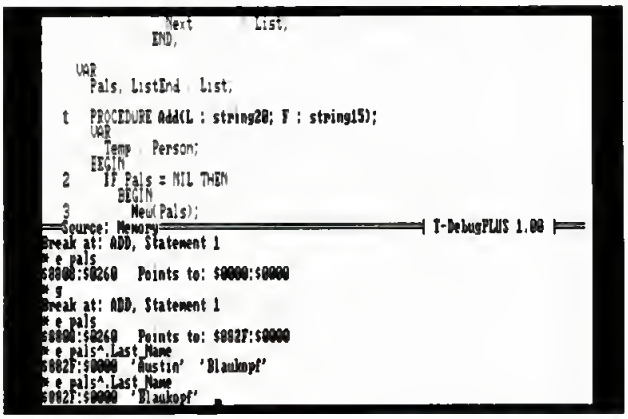
- trace through Turbo Pascal code one line at a time;
- set permanent and temporary breakpoints at a procedure, function, or particular line of source code;
- examine or change the values of variables;
- and view any part of program code while debugging.

The program calls on Turbo Pascal itself to compile the code, so a supported version of Turbo is essential. *TDebugPlus* works with all three versions of the latest release—Turbo Pascal, Version 3.01A; Version 3.00B with 8087 support or with Binary Coded Decimal support; or plain Version 3.00B.

In use, *TDebugPlus* gives a vertical split-screen display. The top half displays the source code, with the current line highlighted. Interactive debugging takes place in the bottom half. A single keystroke toggles between the debugging screen and the program's own output screen. All data types, including arrays and records, are accessible for examination or modification. You can set breakpoints at a particular procedure (or function) or at a line number.

*TDebugPlus* has its limitations. It can't reliably debug files with overlays or simply dump areas of memory. If a program cannot be run from memory within Turbo Pascal—for example, a terminate-stay resident program (TMAP)—*TDebugPlus* cannot debug it. However, the related TMAP program will create a standard format .MAP file. Any symbolic debugger that works with the Microsoft languages (SymDeb is supported; I tested it with ATRON Software's *Source Probe* and *Periscope* and had no problems) can accept this .MAP file.

It's possible to do serious software development without a source-code debugger, as Turbo Pascal programmers have shown, but it's not easy. Some bugs just can't be found any way but interactively. Now that *TDebugPlus* is available, no Turbo programmer should be without it. ■




*TDebugPlus keeps source code in the top of the screen, while debugging takes place below. Above, the debugger examines and changes the value of a variable*

PC MAGAZINE FACT FILE

***TDebugPlus***
TurboPower Software
3109 Scotts Valley Dr.
Scotts Valley, CA 95066
(408) 438-8608
**List Price:** $60
**Requires:** 256K RAM, two disk drives, Turbo Pascal (Version 3.01A or 3.00B), DOS 2.0 or later.
**In Short:** A true source-code debugger for Turbo Pascal, with the added benefit of enabling other symbolic debuggers such as ATRON Software's *Source Probe*.

CIRCLE 426 ON READER SERVICE CARD

# Instant-C 2.0 Links Code With External Libraries

PC HANDS ON

BY ROLAND RACKO

Rational Systems' upgrade to *Instant-C*, its interpreter for the C language, moves this product from being simply good to being a real winner. New features improve the language training and debugging environment, but most appealing to software developers is *Instant-C*'s ability to link object modules from any *Microsoft C*– or *Lattice C*–compatible programs.

*Instant-C* differs from other C language interpreters by its ability to produce a standalone executable form of the ASCII text source files. It does this by secretly compiling the source into native PC object code as you enter, correct, and run during the debugging activity.

A simple command causes the results of these secret activities to be saved to a normal .EXE file on disk. This file may be later run at full native object code speed.

This new release enhances the professional software aspect by allowing dynamic linking of object modules from other vendors' compilers or tool kits (such as Greenleaf's) during debugging. The language support has been brought up to full K & R standards.

The library contains many useful MS-DOS interface routines, as well as some powerful real-time interrupt-handling aids. I found the Watch debugging command especially handy for discovering when a variable was being modified by my bad code logic.

If you have an earlier version, the Watch command and object module linking facility will be a welcome improvement. If you are looking for an interpreter, *Instant-C*'s features make it a top choice. ■

PC MAGAZINE FACT FILE

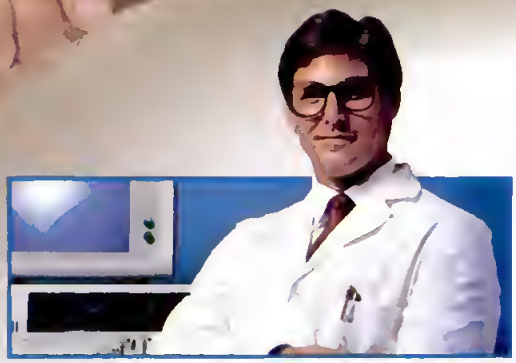
***Instant-C*, Version 2.0**
Rational Systems Inc.
P.O. Box 480
Natick, CT 01760
(617) 653-6194
**List Price:** $495; free upgrade to registered users.
**Requires:** 512K RAM.
**In Short:** Rational Systems' upgraded C interpreter is a real winner. It differs from other C interpreters because it can produce a standalone executable form of the ASCII text source files. Not copy protected.

CIRCLE 431 ON READER SERVICE CARD

# Maynard Has A Little Surprise For IBM PC Users.

**Surprise,™ Maynard's new high-speed board increases your IBM PC's* speed up to 2½ times, and doesn't take up an expansion slot!**

"I just calculated my Lotus spreadsheet in a fraction of the time it used to take! Maynard's new Surprise is fast!"



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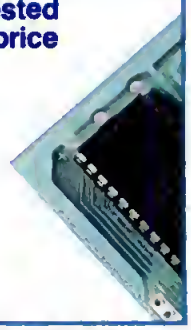
"I installed Maynard's Surprise even though I didn't have any expansion slots left! Was I surprised! Now my PC's faster than ever!"

*IBM PC and XT are trademarks of International Business Machines. Compaq is a trademark of Compaq Computer Corporation. NCR is a trademark of NCR Corporation. Prices for Compaq and NCR Model 4 are slightly higher.

just **$249!** suggested retail price

- increases PC speed up to 2½ times!
- doesn't use an expansion slot!
- installs in seconds!
- works with the IBM PC and XT, Compaq, and NCR Model 4*!
- surprisingly low cost!



**Available at the finest computer stores.**

CIRCLE 478 ON READER SERVICE CARD

## Maynard Electronics

**Shaping tomorrow's technology.**

460 E. Semoran Blvd., Casselberry, FL 32707 305/331-6402

# IBM's new 2,400 bps PC Modems give you an easy choice:

# Either

**Stand-alone.**
**The IBM 5842**
**2,400 bps Modem.**

Either way, you can't go wrong.

With IBM's new modems and a personal computer you can tap into information at a very impressive 2,400 bits per second (bps).

That translates into a binary file transfer speed of nearly 13 K characters per minute—or over six pages worth. Now imagine the impact that can have on your long distance telephone bill.

But these new modems aren't just fast, they're also versatile. They can both send and receive data asynchronously at speeds ranging from 2,400 bps down to 75 bps.

Both modems are compatible with the popular "AT" command set, as well as the IBM command set. And they have been tested for compatibility with leading PC communications software such as Crosstalk™ XVI, Microsoft® Access, Kermit, Smartcom® and Smartcom II®

# or

**The Automatic Modems**

These modems feature Automatic Adaptive Equalization at 2,400 and 1,200 bps—which means they will continuously fine-tune themselves to compensate for changes and noises on the telephone line. The result is, you can receive data over a wider range of telephone line conditions.

Both modems also feature automatic or manual answering and dialing. They'll automatically switch to pulse dialing if tone dialing doesn't work. They have automatic redialing. And once a connection is made, automatic speed detection. They also have automatic detection of a voice or a failed call.

**A Modem with a Memory of Its Own**

The stand-alone IBM 5842 2,400 bps Modem offers some additional features. It can also send and receive data synchronously at speeds of 2,400 bps or 1,200 bps. You'll find extensive "Help" menus. A dial directory for 20 phone numbers. A log-on directory for five log-on sequences. A built-in pattern generator for self testing. Diagnostics implemented from the front panel as well as from the computer keyboard. And a complete array of LED Status Indicators to give you a quick visual check on what's happening.

**Internal.** The IBM Personal Computer 2,400 bps Modem.

**Which One Is for You?**

The internal IBM Personal Computer 2,400 bps Modem is designed to occupy a half slot in the IBM PC, XT, AT and 3270 PC.

The stand-alone IBM 5842 2,400 bps Modem is compatible with all models of IBM Personal Computers. And, in addition to the features mentioned above and its internal power supply, the significant difference is that a stand-alone modem can be moved from PC to PC more easily than an internal modem.

If you feel that 2,400 bps is more modem than you need, we also offer the stand-alone IBM 5841 1,200 bps Modem, and the internal IBM Personal Computer 1,200 bps Modem.

For the Authorized IBM PC Dealer nearest you—or for free literature on the IBM family of PC Modems—call 1 800 IBM-2468, Ext. 141/EM. Or you can contact your IBM marketing representative.

IBM®

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CIRCLE 162 ON READER SERVICE CARD

# Nobody licks our Lips.

LIPS 10 is emerging as the champion in Laser Image Printing Systems. As a second-generation printer, it beats all contenders to the punch. In value, as well as in performance.

It gives you a 10 page per minute print speed. That's 25% faster performance than the 8-count of first generation laser printers.

Want endurance? It delivers up to 600,000 pages during its long life cycle — six times longer than the leading challenger. That means, you can count on its low cost of ownership.

LIPS 10 goes the distance. It's made to print 15,000 pages per month, surpassing the 3,000 pages per month of its competitors.

You also get the style you're looking for. A big round of fonts and graphics. And PC software compatibility with three emulations that lets it take on the most popular applications. Plus, a smart panel that features a 40-character English text LCD display for ease of use.

The LIPS 10 laser printer. Compared to all others, it's clearly the champion.

C.ITOH
CIE Terminals

**CIE Terminals, Inc.**
**2505 McCabe Way, Irvine, CA 92714**
**Telephone: (714) 660-1421 (800) 624-2516**

CIRCLE 348 ON READER SERVICE CARD

## ■ COMMUNIQUÉS ■ EDITED BY BILL HOWARD

### Finally! Someone Who'll Like the AT Hard Disk

From a requisition justification form for a new PC received by the data processing department at the Swedish Hospital Medical Center in Seattle:

"Primary Use: Word processing, spreadsheet, data analyses, and annihilation."

### Why Editors Keep Large Wastebaskets Handy

"TeleVideo Systems Inc. finds that answers to the problems with all LANs, including its own, are secrets of success in creating the right mix of vendor, VAR, and user acceptance."—*TeleVideo press release*

### Let's Make a Deal

*PC-Desk*, a slow *SideKick*-like pop-up desk accessory from Software Studios (8516 Sugarbush, Annandale, VA 22003), has not one selling price but three.

In an advertisement aimed at dealers, Software Studios says the "suggested retail" price for *PC-Desk* is $99 or $79 through December on a special promotion. But the cover price—the price printed on the packaging—is $125.

### R.I.F.

"IBM has asked its employee to take accrued vacation, plus cash, to help the company fight its business slump . . ."

—MIS Week, *July 21, 1986*

### Chip of Fools

"The 80286 is a much more sophisticated ship supporting four levels of protection."

—*Foreword by Bill Gates to Microsoft's* MS-DOS Technical Reference Encyclopedia

*Heard or seen unything offbeat, unusual, or just ploin dumb ubout the computer industry? Send your offerings to Communiqués, PC Magazine, One Pork Ave., New York, NY 10016; (212) 503-5293 or MCI Mail 157-9301. Contributors receive $50 and a PC Magazine T-shirt.*

*Contributors this issue: Edward Gordon (PC requisition), Potricia Phelps (IBM employee), Robert Gill (PC Desk), Jonathan Matzkin (TeleVideo).* ■

### Dear PC Tutor: Pleeze to Rekommend a Good Grammar Checker for My PC . . .

"We like to know more information about your soft.

"We have a PC IBM Number 919215.

"We will be very glad to received your answer.

"Thanks and sincerely yours."

—*Letter received by* PC Magazine*'s PC Tutor*

### Ideaphone

(continued from page 36)

calls can be picked up by someone else before they ring on your system. A special switch on the board prevents the system from dialing out. This feature allows you to use the system as a receive-only telephone for special applications.

The Ideaphone lacks a few of the features found on fancier (and more-expensive) desk telephones—like the ability to sense a busy signal and periodically redial, as well as the ability to conference two lines.

Otherwise, the Ideaphone's only really negative feature is that it takes about 3 seconds to reset after completing a call. Telephone users in the United States expect a dial tone to be there when they pick up the receiver. Waiting 3 seconds to dial a new number doesn't seem like much, but telephone power users are just as picky about speed as microcomputer power users are.

Will the Ideaphone be a winner? Maybe. Ideatech supplies flexible telephone hardware and good ways to interface the Ideaphone with applications software. But the key to success will depend on what applications other companies design for this system. ■

Illustrations: Frank Marcellano

## ■ NEW ON THE MARKET ■ PAUL M. STAFFORD

### Low-Cost Slidemaker Offers High-Resolution Presentation Images

**Presentation Technologies** aims Imagemaker, a PC-based desktop slidemaker, at business presentation applications. The $4,995 device produces color 35mm slides, with 8,000-line resolution, from PC graphics software.

Imagemaker uses a combination of phototypesetting and plotter technology and uses typesetting characters, symbols, and shapes on film from font cartridges, with text proportionally spaced and automatically kerned. In graphics mode, it projects a beam of light onto the film, manipulating it like a plotter pen on paper.

It supports two film types: Ektachrome for high-quality slides, and Polaroid Polachrome for instant results.

**List Price:** Imagemaker, $4,995. Presentation Technologies, 743 N. Pastoria Ave., Sunnyvale, CA 94086; (408) 749-0746.

CIRCLE **443** ON READER SERVICE CARD

*Presentation Technologies' $4,995 Imagemaker allows users to produce 35mm color slides with 8,000-line resolution from standard business graphics software by writing with light directly onto film, much as a plotter does with pens on paper.*

### AST RAMpage/EGA Offers 2 Megabytes Expanded RAM, Enhanced Graphics

Continuing the recent trend of greater board-level integration, **AST Research** has introduced its RAMpage/EGA, a 2-megabyte AT-compatible expanded RAM card with IBM EGA–compatible color graphics on the board.

Retailing for $1,795 with 2 megabytes of memory, the RAMpage/EGA supports both the Lotus/Intel/Microsoft expanded memory specification and AST's enhanced EMS and can allocate RAM to backfill conventional memory up to 640K bytes, as well as for expanded or extended memory. As well as the EGA, the display adapter supports IBM's CGA and monochrome standards and Hercules's monochrome graphics standard.

**List Price:** RAMpage/EGA, $1,795. AST Research Inc., 2121 Alton Ave., Irvine, CA 92714; (714) 863-1333.

CIRCLE **434** ON READER SERVICE CARD

### Turbofonts: Scientific, Foreign Characters For Top Word Processors

Scientists and users who write in foreign languages are faced with a difficult choice: they can either use one of the top-selling English-language word processors and improvise the special characters they need or settle for a special word processor that may not have all the features they need.

**Image Processing Software**'s $149 *Turbofonts* is an attempt to give such users the best of both worlds by adding screen and printer support for special characters to top-selling word processors such as *WordPerfect*, *Microsoft Word*, *MultiMate*, *OfficeWriter*, *Volkswriter 3*, *XyWrite III*, and others.

*Turbofonts* is a memory-resident program that takes over the screen, printer, and keyboard, allowing users a choice of over 30 predefined character sets or customization from a library of over 1,000 characters. The program works as is with an EGA and display or with an optional $75 PROM with other configurations

**List Price:** *Turbofonts*, $149; optional character PROM, $75. Image Processing Software Inc., 4414 Regent St., Madison, WI 53705; (608) 233-5033.

CIRCLE **439** ON READER SERVICE CARD

## HOT PROSPECT

### NEC's Multispeed: 9.54-MHz Laptop Weighs 11 Pounds, Runs DOS

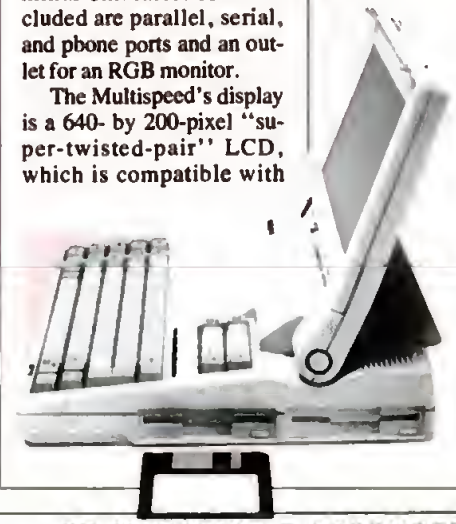
**NEC Home Electronics** has moved into the DOS-on-the-run market with its 11-pound, $1,995 Multispeed laptop computer.

The Multispeed's dual-speed power (software-selectable 4.77 and 9.54 MHz) derives from its NEC V30 microprocessor. Two 720K-byte 3½-inch floppy disk drives provide disk storage. The Multispeed includes 640K RAM and 512K bytes of built-in ROM programs, including an outliner, a filer, a notepad, a dialer, and a terminal-emulator. Also included are parallel, serial, and phone ports and an outlet for an RGB monitor.

The Multispeed's display is a 640- by 200-pixel "super-twisted-pair" LCD, which is compatible with IBM's Color/Graphics Adapter, and the keyboard features 85 keys, including a separate numeric keypad. A Hayes-compatible modem is a $400 option, as is a $99 adapter that lets you access a desktop PC's disk drives.

**List Price:** Multispeed, $1,995; modem, $400; disk drive adapter, $99. NEC Home Electronics (USA) Inc., 1401 Estes Ave., Elk Grove Village, IL 60007; (800) 323-1728; (312) 228-5900.

CIRCLE **433** ON READER SERVICE CARD



*NEC's $1,995 Multispeed laptop portable runs at a top speed of 9.54 MHz and contains 512K bytes of ROM-based software.*

### Modular Storage System Includes Disks, Tape, And Soon, CD-ROM

**Western Digital Corp.**, the dominant maker of PC disk controller boards, has introduced a line of stackable small-footprint backup storage devices called VersaStak that are connected via a patent-applied-for interlocking switch. One PC board provides the SSC1 interface to a 225-watt base power system that drives up to seven devices, from an 85-megabyte hard disk with a 30-millisecond access time to a 60-megabyte tape unit running at 5 megabytes per minute in streaming mode.

CD-ROM and CD-WORM modules will be added in several months. An intelligent file server is also planned. All VersaStak modules measure 12.5 by 9.4 by 5 inches.

**List Price:** VersaStak base, $395; AT adapter card, $195; XT adapter card, $150; 85-Mbyte disk drive, $2,995; 170-Mbyte disk drive, $3,995; 60-Mbyte tape unit, $1,395; CD-ROM, $1,795. Western Digital Corp., 2445 McCabe Way, Irvine, CA 92714; (714) 863-0102.

CIRCLE **442** ON READER SERVICE CARD

## Laser Printing Systems Optimized to Print Forms

Two integrated printing systems may eliminate the need for preprinted paper forms.

The $5,995 Formwriter 2X Laser Printing System, from **Electronic Forms Systems**, consists of a laser printer and software that merges applications program data with electronically stored forms. The system generates up to eight completed forms per minute, and up to 5,000 electronic forms and 150 fonts can be stored on a hard disk and accessed by the system's *Formdriver* software.

The $3,995 Laserpower II, from **CMS**, prints ten pages per minute and features 18 resident type fonts. It also offers a proprietary command language for generating forms, business graphics, and bar codes. The printer has a claimed monthly duty cycle of 15,000 pages and a total lifespan of 600,000 pages.

As an introductory offer, CMS bundles Digital Research Corp.'s *GEM Graph* and *GEM Desktop* presentation-quality graphics packages with the Laserpower II.

*CMS's $3,995 Laserpower II contains 18 resident type fonts and a proprietary page-description language for generating forms, graphs, and bar codes.*

**List Price:** The Formwriter 2X Laser Printing System, $5,995. Electronic Forms Systems, 2395 Midway Rd., Carrollton, TX 75006; (800) FORM-FREE.

CIRCLE 444 ON READER SERVICE CARD

**List Price:** Laserpower II, $3,995. CMS, 3080 Airway Ave., Costa Mesa, CA 92626; (714) 549-9111.

CIRCLE 445 ON READER SERVICE CARD

## Ashton-Tate, Tom Rettig Introduce Utilities For dBASE Programmers

In the rush to provide better programmer's tools, **Ashton-Tate**'s *dBASE* family of programmable database management systems has not been forgotten.

Ashton-Tate itself has announced *dBASE Programmers' Utilities*, a set of 35 *dBASE* and 12 DOS utilities designed to let programmers recover damaged *dBASE* files, create screen designs, and perform rapid disk searches. The utilities work with both *dBASE III Plus* and all versions of *dBASE III*.

Consulting company **Tom Rettig Associates**' first foray into the world of commercial software is its $99.95 *Tom Rettig's Library*, a collection of 140 utilities in separate volumes for *dBASE III Plus* and **Nantucket Software**'s *Clipper*.

**List Price:** *dBASE Programmers' Utilities*, $89.95. **Requires:** *dBASE III* or *dBASE III Plus*. Ashton-Tate, 2101 Hamilton Ave., Torrance, CA 90502-1319; (213) 329-8000.

CIRCLE 435 ON READER SERVICE CARD

**List Price:** *Tom Rettig's Library*, *Clipper* and *dBASE III Plus* versions, $99.95 each. **Requires:** *Clipper* or *dBASE III*. Tom Rettig Associates, 9300 Wilshire Blvd., #470, Hollywood, CA 90212-3237; (213) 272-3784.

CIRCLE 436 ON READER SERVICE CARD

## C Language Tools Take Off: C++ for PCs, Window-Creation Routines

The C programming language has risen in popularity to the point that some pundits are declaring C the number-one PC language. A flurry of recent C-related product announcements reflects this phenomenon.

**Lifeboat Associates**' *Advantage C++* is a $495 PC implementation of AT&T's *C++*. In addition to providing enhanced type-checking and data-abstraction features, *Advantage C++* is fully compatible with both Microsoft Corp.'s and Lattice's C compilers.

**Greenleaf Software**'s $225 *DataWindows* is a library of C windowing and data-entry routines. The package includes over 135 functions. Source code for the routines is available for an additional $225.

**List Price:** *Advantage C++*, $495. **Requires:** 512K RAM, LINK 3.0 or later, DOS 2.0 or later. Lifeboat Associates, 55 S. Broadway, Tarrytown, NY 10591; (914) 332-1875.

CIRCLE 437 ON READER SERVICE CARD

**List Price:** *DataWindows*, $225; source code, $225. **Requires:** 256K RAM (512K recommended). Greenleaf Software, 1411 LeMay Dr., #101, Carrollton, TX 75007; (214) 446-8641.

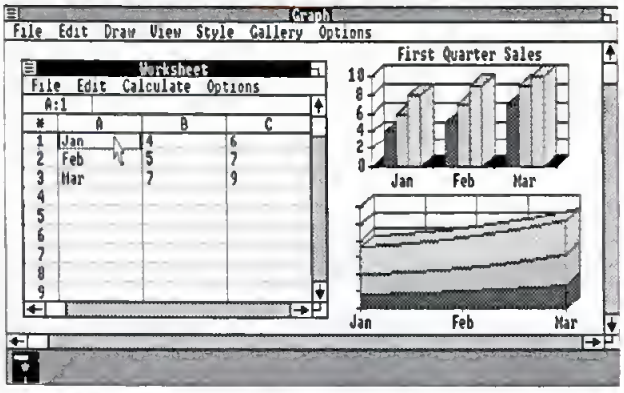
CIRCLE 438 ON READER SERVICE CARD

## 1-2-3-to-AutoCAD Converter, Windows Graph! Expands Graphics Options

The business of business presentation graphics has gotten a shot in the arm from three programs that expand graphics options by interfacing with established programs.

**Neuendorf Systems**' $100 *P2D* converts *1-2-3*-generated .PIC-format files to *AutoCAD*'s .DFX format. This allows you to generate simple graphs from their spreadsheet data and enhance them using *AutoCAD*'s considerable resources.

**Micrografx** has added to its collection of *Microsoft Windows*–based CAD and drawing software (*Windows DRAW!* and *In*a*Vision*) with a presentation graphics package. *Windows Graph!* sells for $395 and includes a run-time *Windows* module, so it does not require *Windows*. It supports the Dynamic Data Exchange protocol, allows linking of worksheets into charts, and includes a variety of interactive drawing features.




*While it can stand alone, Micrografx's $395* Windows Graph! *supports all* Windows *functions, including the clipboard and the Dynamic Data Exchange protocol.*

**List Price:** *P2D*, $100. **Requires:** 256K RAM. Neuendorf Systems, 281 Continental Dr., Pottstown, PA 19464; (215) 327-2970.

CIRCLE 440 ON READER SERVICE CARD

**List Price:** *Windows Graph!*, $395. **Requires:** 384K RAM, DOS 3.0 or later. Micrografx Inc., 1820 Greenville Ave., Richardson TX 75081; (214) 234-1769.

CIRCLE 441 ON READER SERVICE CARD

# Express 60-Meg Hard Card: Wide Body, Sturdy Design

PC HANDS ON

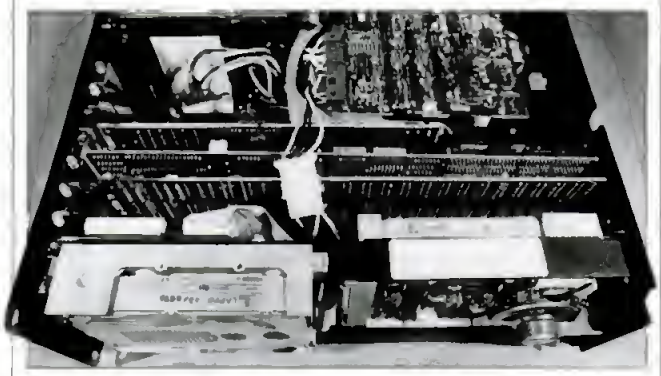
BY HOWARD MARKS

Express Systems' 60-megabyte Hard Disk Card is the ultimate development in these bolted-together hard disk cards. Express has taken two Lapine Technologies 20-megabyte 3½-inch Winchester disk drives, an OMTI 5527 RLL-encoded half-length controller (allowing 30-megabyte storage on what would otherwise be a 20-megabyte disk), and the required brackets and cables to create a 60-megabyte hard disk card. Express charges $1,095—about what others charge for 20- or 30-megabyte hard disk cards.

Although Express Systems has advanced the state of the art by creating this 60-megabyte hard disk card, the Hard Disk Card does have several significant drawbacks. Most important, it is large enough to cover three slots. The company recommends installing it in slot two (second from the speaker), where it will occupy slots one and two and the space up to the edge of the case.

The Hard Disk Card runs rather warm and does generate quite a bit of heat. When placed in a clone with several other cards, including a Genoa Spectrum, which also runs warm, my system showed signs of overheating. Aside from the threat of imminent failure, running warm causes the problem of premature aging of the PC's chips.

The disk drives used in the Hard Disk Card are of ruggedized construction and include a mechanism to lift the heads off the media when powered down. The card is about as fast as most 20- to 30-megabyte add-on hard disks with an average access time of about 80 milliseconds. Most 60-megabyte add-on disk drives use voice coil positioners with average access times in the 20- to 40-millisecond range.



*Express Systems' chubby Hard Disk Card uses two slots if you use slots one and two on a PC, next to the cover; otherwise, the 60-megabyte card needs three.*

The two disk drives are addressed as a C: and D:, though the Hard Disk Card includes a utility that allows you to run the card as a 60-megabyte volume.

Express Systems' 60-megabyte Hard Disk Card is a good buy for a PC that has spare slots and doesn't need fast access. But it should be avoided if your PC already runs warm. ■

PC MAGAZINE FACT FILE

**Hard Disk Card, Model 6060**
Express Systems
1254½ Remington Rd.
Schaumberg, IL 60196
(312) 882-7733
**List Price:** $1,095
**Requires:** DOS 2.0 or later.
**In Short:** A 60-Mbyte hard disk card that needs two or three slots.

CIRCLE 427 ON READER SERVICE CARD

# FoxBASE+ Maintains Stunning Speed, Adds dBASE III Plus Compatibility

PC HANDS ON

BY GLENN HART

When PC Labs tested Fox Software's *FoxBASE* in Project Database II (*PC Magazine*, Volume 5 Number 12), it earned high marks for solid performance. *FoxBASE* is based on *dBASE II* syntax, though, and so the many advances in *dBASE III Plus* weren't available in that package.

Now Fox Software has released *FoxBASE+*, which is derived from *dBASE III Plus*. *FoxBASE+* is basically a pseudo-compiler: your source code is compiled on the fly as it is loaded, or you precompile it for faster loading from disk. The compiled code can be run in the normal *FoxBASE+* environment or by a special run-time-only version (multiuser versions are available, too).

Developers can distribute the run-time version with their compiled code to hide the source from the end user. The run-time approach has a reputation for slowness, but this definitely doesn't apply to *FoxBASE+*.

Some other *dBASE* clones offer an assortment of nonstandard language extensions. Fox Software has decided to take a more conservative approach, with only a few new commands to tempt the programmer. The most notable additions are memory variable arrays and multiple relations out of a database. This last feature permits far more complex interrelationships between data files with much less programming.

Initial tests of *FoxBASE+* were simply stunning. I ran the two reports written in *dBASE III Plus* for Project Database II. *FoxBASE+* ran them with no changes, as did Nantucket's *Clipper*. *FoxBASE+* was four to five times faster than *dBASE III Plus* and well over 40 percent faster than *Clipper*.

Fox Software claims to have run a quarter-million lines of *dBASE III Plus* code without any changes. *FoxBASE+* is extremely compatible, but it does have some significant omissions. There's no Assist system (which developers won't miss), and several of the newest *dBASE* enhancements—such as View, Query, Catalog, and the screen-painting system—aren't included.

New versions of *Clipper* and WordTech's *dB/Compiler* are due soon, and PC Labs will look at them, too. But, on the basis of this first look, *FoxBASE+* zooms to the head of the *dBASE*-compatible class. ■

PC MAGAZINE FACT FILE

***FoxBASE+***
Fox Software Inc.
27475 Holiday Ln.
Perrysburg, OH 43551
(419) 874-0162
**List Price:** Development copy, $395; royalty-free, run-time copy, $500.
**Requires:** 512K RAM, two disk drives, *dBASE III Plus*, DOS 2.0 or later.
**In Short:** A fast executing *dBASE*-compatible interpreter also available in a run-time version. Not copy protected.

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## QUICK LOOKS

# Orbiter: Simulating Space Labor

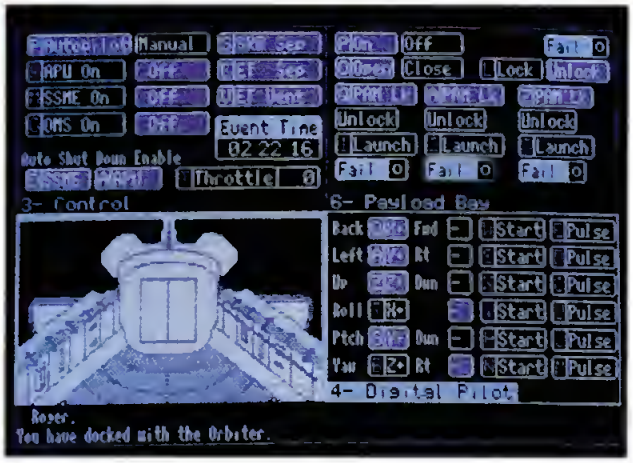
HANDS ON

BY STEVE SAGMAN

No doubt fans of *Gato*, the submarine simulation game from Spectrum HoloByte, are eager to rush out and try the company's new space-shuttle simulation, *Orbiter*. Many will be disappointed.

Unlike *Gato*, which is really a game, *Orbiter* is a highly accurate simulation. In fact, it's so accurate that it laboriously pinpoints the shuttle's exact position using elaborate orbital-mechanics computations. While that kind of precision will be a turn-on to astrophysicists and space-travel aficionados, it'll bore anyone else.

During a mission, *Orbiter* quickly bogs down under the complexity of all its calculations, and it uses too much precious CPU time to update bland graphics screens of control panels with only a few interesting out-the-window views. Often, you'll watch 4 or more real seconds pass for each second of simulation time. This program seems to have been designed for the computing power of an 80386 machine.




*Orbiter's regularly updated control panel may give you the sensation of being in charge of the space shuttle, but it's short on visual impact.*

Working through the mission scenarios and recovering from random mechanical complications during flight (but not during launch) can be fascinating and challenging. And the number of conditions the program tracks is remarkable. But unless your PC is optimized for speed (an 80286 machine or an 8087 minimum), you'd better bring along at least one other crew member for diversion.

**List Price:** *Orbiter*, $49.95. **Requires:** 256K RAM, color/graphics adapter, DOS 2.0 or later. Spectrum HoloByte Inc., 1050 Walnut St., #325, Boulder, CO 80302; (303) 443-0191.

CIRCLE **428** ON READER SERVICE CARD

# Goal-Seeker Answers Limited 1-2-3 Queries

HANDS ON

BY IRIS KNITTEL

*Goal-Seeker*, a memory-resident utility program that moonwalks through *1-2-3* spreadsheets, works backward from a goal you establish to find "what if" contingencies almost instantly.

The program uses just 40K bytes of RAM, and it's easy to learn; Alt-Spacebar brings up the menu. You can set the parameters of *Goal-Seeker*'s search, and you can also piggyback goal-seeking in batch style.

The program does have a number of limitations. It will vary only one data element at a time to achieve its goal. In addition, the goal cell must be a formula that directly or indirectly references the cell where the solution will appear. And that solution has to be a fixed-formatted number (no dollar signs or percentages).

*Goal-Seeker*'s best application is in complex models where you set various goals and want to test the interplay of individual factors. The program was developed by Information Software of Dallas and is now being marketed by Brown Bag Software.

**List Price:** *Goal-Seeker*, $49, plus $5 shipping. **Requires:** *1-2-3*, plus 40K RAM free. Brown Bag Software, 2105 S. Bascom Ave., #164, Campbell, CA 95008; (800) 523-0764; (800) 323-5335 (in Calif.).

CIRCLE **429** ON READER SERVICE CARD

# Imagenhancer Plots on a Printer

HANDS ON

How to get an Epson FX printer to do the job of a plotter.

BY HOWARD MARKS

Like to have a plotter but can't justify the expense? Alps America has come to your rescue with its Imagenhancer card, which enables an Epson FX or compatible printer to accept Houston Instruments DMP-29 or DMP-41 plotter commands. You can even get color plots from an Epson JX-80.

The Imagenhancer also serves as a printer buffer for standard text sent to the printer. It installs as either COM1: or COM2: and drives a standard parallel printer.

Since the card has its own processor and 225K bytes of memory, it performs the time-consuming vector-to-raster conversion necessary to draw plots on a dot matrix printer. While this enhancement doesn't speed up the actual printing of the graph, it does free up the PC much sooner. Printing a graph from *Supercalc*, the computer was free to do other work four times faster than when the same graph was printed with an Epson driver.

Imagenhancer always uses the highest-density graphics mode available on the printer, creating very sharp, attractive graphs.

The Imagenhancer cuts the time your computer is tied up printing graphs, allows you to use standard plotter commands on your Epson printer, and acts as a printer buffer to boot.

**List Price:** Imagenhancer, $595. **Requires:** Epson FX-compatible printer, DOS 2.0 or later. Alps America, division of Alps Electric (USA) Inc., 3553 N. First St., San Jose, CA 95134; (408) 946-6000.

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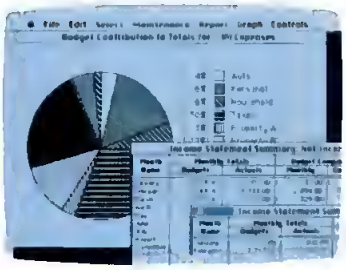

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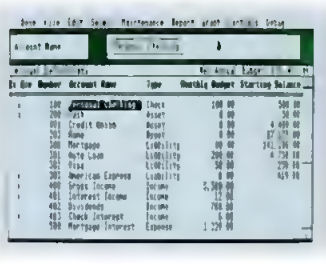

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CIRCLE 525 ON READER SERVICE CARD

## ■ PC UPDATE ■ PEGGY GAVAN

**Turbo Prolog,** Version 1.1, offers increased support for natural language databases and expert systems, enhanced compilation speed, and reduced memory requirements. Upgrades are free to registered users. Borland International, Scotts Valley, Calif.; (408) 438-8400.

* * * * *

Microsoft Corp. has released Version 3.0 of ***Microsoft Project***. The new version links to Primavera Systems' ***Primavera Project Planner*** and supports several network systems, including Novell's NetWare, Ungermann-Bass's Net/One, 3Com Corp.'s Ethernet, IBM Corp.'s PC Network, and *Microsoft Networks*.

* * * * *

***Relay Gold***, Version 2.0, includes 3270 emulation board support, expanded documentation, and an applications program interface. Upgrades are free to users who purchased Version 1.0 after June 9, $40 for all other users of Version 1.0, and $100 for users of *Relay*. VM Personal Computing, Danbury, Conn.; (800) 222-8672.

* * * * *

***Yale Graphics Graphstation*** from Software Clearing House is being bundled with Mouse Systems Corp.'s **Fieldmouse**. The package sells for $495, previously the price of the software by itself. Mouse Systems Corp., Santa Clara, Calif.; (408) 988-0211.

* * * * *

***FormTool***, Version 2.0, features a merge capability that automatically merges data from *dBASE*, DIF, or ASCII files to produce customized forms. The upgraded version also includes word processing capabilities such as word wrap and text justifying. Registered users can upgrade for $25. Bloc Development, Miami Beach, Fla.; (305) 531-5486.

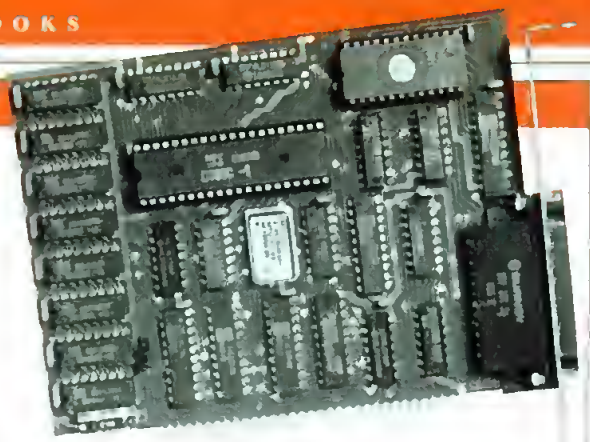
* * * * *

Fifth Generation Systems has released ***Fastback***, Version 5.13. The new version is optimized for use with the Intel 8086 and 80286 microprocessors. Version 5.13 is not copy protected, and upgrades are $10 for registered users. Fifth Generation Systems, Baton Rouge, La.; (800) 225-2775.

* * * * *

***Managing Your Money***, Version 3.0, is an enhancement that supports the new federal tax code, enabling users to explore the effects of the changes on their individual finances. The new version also incorporates support for Chase Manhattan's *Spectrum* home banking system. Upgrades are $45.95 for registered users. MECA, Westport, Conn.; (203) 222-1000.

*The new tax code made on upgrade to Monaging Your Money necessary, but Version 3.0 also offers a number of enchantments, including support for on-line banking.*



*Ditron Corp.'s internal 256K-byte Printer Buffer now has the company's new* Soft Accessories *utility program.*

**Ditron Corp.** has added its new *Soft Accessories* utility program to its internal **256K-byte Printer Buffer**. The software add-on allows users to erase the printer buffer's memory, control data output between printers attached to a single computer, and print multiple copies of documents from the keyboard. Upgrades are $25. Ditron Corp., Glendale, Ariz.; (602) 938-3165.

* * * * *

3Com Corp. reduced the prices on its Ethernet line of adapters by as much as 18 percent. The basic **EtherLink** adapter was reduced from $650 to $595, and the **EtherLink Plus** dropped $200, to $895. In addition, 3Com has bundled its *3+Menus* menu-driven interface with its **3+Share** network package. 3Com Corp., Mountain View, Calif.; (415) 960-9400.

* * * * *

**In brief:** Version 2 of ***PC Tools*** requires only 64K bytes in its memory-resident mode and supports the Lotus/Intel/Microsoft expanded memory specification. Upgrades are $5 for registered owners of ***PC Tools*** and $15 for registered users of any other Central Point Software product. Central Point Software, Portland, Oreg.; (503) 244-5782...**LaserControl,** Release 3.0, has several new features, including laser printer setup, page enhancement, and printer emulation. Registered users can upgrade for $35. Insight Development Corp., Moraga, Calif.; (415) 376-9451...***Chart-Master***, Version 6.2, allows hard disk users to send a series of different charts in succession to a plotter and can import 700 rows of data from other *Chart-Moster* applications. Upgrades are $75 for registered users. Decision Resources, Westport, Conn.; (203) 222-1974...***Protracs***, Version 4.0, tracks from 400 to 2,000 tasks per project and supports local area network environments. Users can upgrade for $10 and a master disk. Applied MicroSystems, Roswell, Ga.; (404) 475-0832...Conographic Corp. reduced the price of its **Cono-Color 40 graphics adapter** to $695, a reduction of 30 percent. Conographic Corp., Irvine, Calif.; (714) 474-1188...Irwin Magnetics reduced the prices on its family of **Backup tape drives** by an average of $200 per model. Prices range from $495 for a 10-megabyte-per-cartridge internal tape drive to $895 for a 40-megabyte compact subsystem. Irwin Magnetics, Ann Arbor, Mich.; (313) 996-3300...***Clip Art Collection, Volume 3***, a $29.95 package featuring sports and recreation illustrations, has been released for use with ***The Newsroom*** and ***The Newsroom Pro***. Springboard Software, Minneapolis, Minn.; (612) 944-3915...***Encore!***, Version 3.1, has a custom screen data entry feature and interfaces for all versions of *1-2-3* and *Symphony*. Registered users should contact Michael Burke of Ferox at (703) 841-0800 for upgrade information. Ferox Microsystems, Arlington, Va....The second edition of ***1-2-3 Tips, Tricks, and Traps*** offers new shortcuts and problem-solving hints for use with *1-2-3*, Release 2. The book is priced at $19.95. Que Corp., Indianapolis, Ind.; (800) 428-5331. ■

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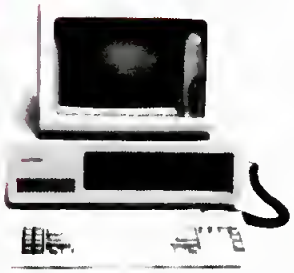

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NITRO MICRO SM

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# PASM86 2.0: Better Syntax Checking, Equate Processing

PC HANDS ON

BY STEPHEN R. DAVIS

Why would anyone consider an assembler other than Microsoft's MASM standard? In the case of the new PASM86, Version 2.0, from Phoenix Computer Products Corp., the reasons might include an improved syntax checker, better equate processing, improved error messages, a larger symbol table, and a variety of professional assembly language aids.

PASM, Version 1.0*x*, was Phoenix's attempt to create a simpler alternative to the overcomplicated MASM. Realizing that bucking the Microsoft standard is akin to trying to get *Flight Simulator* off the ground with the flaps up, Phoenix made Version 2.0 much more MASM-compatible. However, Phoenix has remained true to its original principles.

When Version 2.0 encounters a dangerous or misleading, but legal, construct (such as beginning the name of a variable with a "."), PASM86 now accepts it but generates a warning message. PASM86's superior parser is then careful to generate the proper code. Phoenix's documentation includes many examples where MASM gives no warning message under the same conditions but proceeds to generate perplexing error messages later on.

(continued on page 59)

*The single-step mode in PASM86's full-screen debugger, Pfix Lite, monitors your code and changes in the microprocessor's status as your program executes.*

PC MAGAZINE FACT FILE

**PASM86, Version 2.0**
Phoenix Computer Products Corp.
320 Norwood Park South
Norwood, MA 02062
(617) 762-5030
**List Price:** $195 (free to registered PASM, Version 1.0*x*, owners).
**Requires:** 184K RAM; LPASM requires 256K RAM.
**In Short:** Microsoft MASM-compatible assembly language package that's ideal for professional software applications.

CIRCLE 422 ON READER SERVICE CARD

# Instant Replay Adds Life To Software Presentations

PC HANDS ON

BY HOWARD MARKS

*Instant Replay* is one of those products with the potential to go from unknown to indispensable in your software library. A worthy rival to the more famous *Dan Bricklin's Demo Program* (by the creator of *VisiCalc*), *Instant Replay* creates software demo disks, tutorials, and prototype screen layouts. Anyone wanting to share his on-screen work has the tools to put those screens into a lively show.

Both *Demo Program* and *Instant Replay* create slide shows, a series of images that can simulate a program's operations or illustrate a structured presentation. You can create screens either by capturing them from the application you're modeling or by using the screen painter included in the program.

The screen painter in *Instant Replay* is more powerful than *Demo Program*'s, with full control of the IBM character set, colors, and attributes. You also can save and retrieve windows separately from the rest of the screen to allow a demo to use windows as overlays.

## Uses Keyboard Macros

*Instant Replay* improves on the *Demo Program* repertoire further by allowing you to use any software product to create demos through its keyboard macro system. *Instant Replay* will memorize all of a demonstration session's keystrokes, along with the delays between them, and will play them back on demand. Using macros, you can capture and include bit-mapped graphics displays in your demos and can demonstrate the speed of the product being demonstrated.

## Has Keystroke Editor

A keystroke editor allows you to add or delete keystrokes and modify the delays between strokes for maximum effect. By using the keystroke macros with the screen painter, you can create impressive demos retrieving windows and moving blocks of text around the screen. You can make interactive demos with point-and-shoot menus to offer selections to the viewer.

You can prepare a demonstration of a package in about the same time it would take to run the demo. *Instant Replay* also includes a text editor similar to *SideKick*'s notepad.

## Used with Plus Series

*Instant Replay*'s screen painter can also be used to define field types and allowable input string attributes, for use with Nostradamus's *Plus* series of code generators to generate procedures callable from Turbo Pascal, Microsoft or IBM Pascal, or Microsoft C.

Included in the $89.95 price is a license to distribute 50 runtime copies with your demos.

*Instant Replay* is an advance in prototyping software and a clear improvement over *Dan Bricklin's Demo Program*. It is recommended to anyone involved in software development. PC

PC MAGAZINE FACT FILE

***Instant Replay***
Nostradamus Inc.
5320 S. 900 East, #110
Salt Lake City, UT 84117
(801) 261-0769
**List Price:** $89.95
**Requires:** 128K RAM, one disk drive, DOS 2.0 or later.
**In Short:** A software demo system that lets you paint screens, memorizes your keystrokes, and lets you add delays to create timed presentations. Not copy protected.

CIRCLE 421 ON READER SERVICE CARD

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*PC Magazine, August 1986, "Achieving The Standard. 12 EGA Boards"

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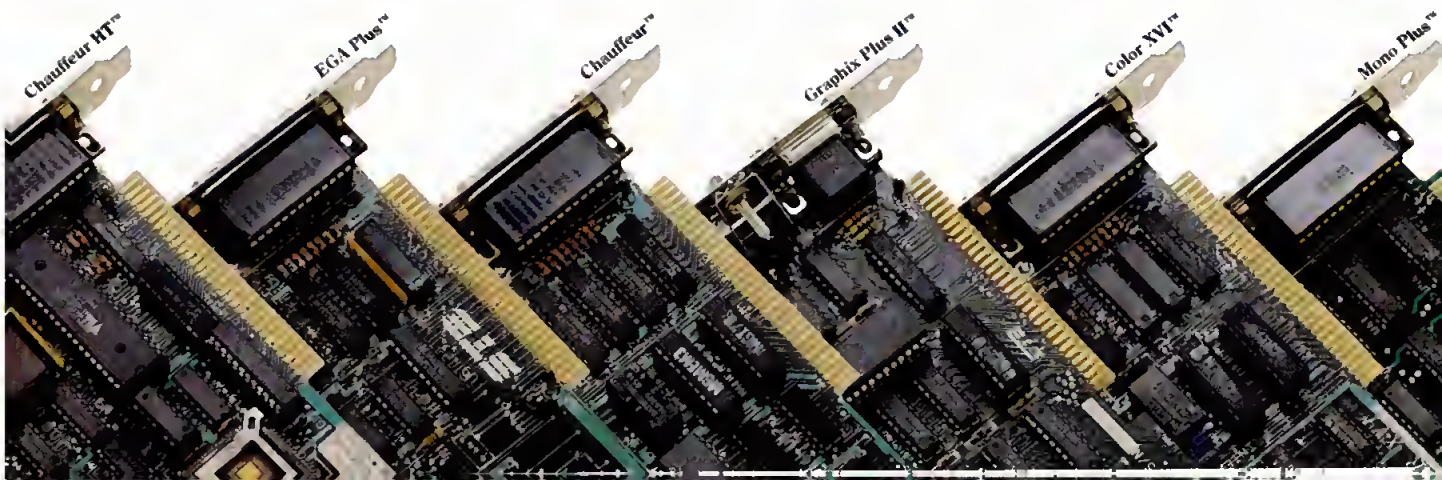
CIRCLE 517 ON READER SERVICE CARD



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System supports all popular software such as Wordstar, dBaseIII, Lotus 123, Multimate, etc.

## Tech PC Triad Multiuser
### Starting From $2599

Tech PC/XT base unit with 640K, and two 360K disk drives.

Separate Intel 80188 microprocessor running at 8 MHz and 512K for each terminal.

Three high resolution monitors, three Selectric style Hi-Tek keyboards, 50 feet of shielded cable to separate the three stations.

System expandable to 32 workstations.

System supports up to six printers.

Full support for multitasking multiterminal use with print spooling for multiple prir.ters, background monitoring of the system, dial up bulletin board support, passwork protection, and file/record locking supporting PC Network protocol.

System supports all popular software such as Wordstar, dBaseIII, Lotus 123, Multimate, etc.

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System supports all popular software such as Wordstar, dBaseIII, Lotus 123, Multimate, etc.

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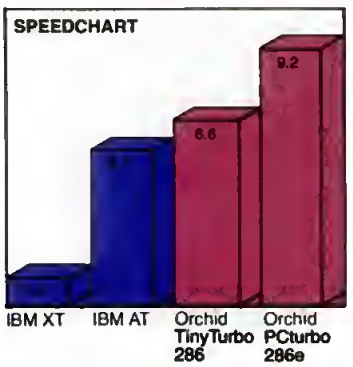


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CIRCLE 492 ON READER SERVICE CARD

# Elgar SPF 550 and SPF 1000: Smooth Defense Against Power Outages

PC HANDS ON

BY WINN L. ROSCH

At 73 and 85 pounds, respectively, Elgar Corp.'s SPF 550 and SPF 1000 standby power supplies promise unquestionably heavyweight blackout-, spike-, and surge-protection for even the most elaborate desktop computer systems. In addition, Elgar's Failsafe utility, supplied with the SPF-series, ranks among the first to give truly automatic protection of your files and data even when your PC is operating unattended.

The SPF 550 will run its full load, 550 volt-amperes, under battery power for 20 minutes; the SPF 1000 can provide 1,000 volt-amperes for 14 minutes. The smaller unit is more than enough for an AT and monitor; the larger one can power a more elaborate installation.

Both units are desk-side rather than desktop companions. The SPF 550 stands 17 by 14 by 9 inches; the SPF 1000 is 2 inches deeper. Both provide a pair of protected, three-prong outlets and only one control, an illuminated on/off switch.

Installation requires nothing more than plugging in the power supply and then plugging your computer into it. Both units use maintenance-free, sealed lead-acid batteries.

As with most standby power systems, the SPF units sit quietly near your PC until a power failure occurs, supplying the computer with filtered and spike-protected electricity from the power line. Their internal battery chargers add no discernible noise to the office environment.

When power fails, the SPF units immediately toggle (switching within 4 milliseconds, according to Elgar) to battery-generated, pulse-width modulated sine-wave (Elgar's description) power. At the same time the circuitry emits a loud electrical whine that makes the built-in warning alarm, which rings every 15 seconds, superfluous—and almost inaudible.

A unique feature—and one of the biggest strengths of the SPF series—is its Failsafe utility. Activated through an RS-232 connection, the Failsafe utility will smoothly and automatically shut down the host computer once a power failure lasts for a duration that you set. The utility steps through a sequence of commands to save keystrokes, files, and data so that nothing is lost if normal power does not return until the SPF runs out of charge.

PC MAGAZINE FACT FILE

**SPF 550**
**SPF 1000**
Elgar Corp.
9250 Brown Deer Rd.
San Diego, CA 92121
(800) 854-2213
(619) 450-0085
**List Price:** SPF 550, $995; SPF 1000, $1,295.
**Requires:** Failsafe utility requires 10K RAM, serial port.
**In Short:** Heavyweight standby power supplies with built-in noise and surge protection and software to shut down computers safely and automatically during lengthy outages.

CIRCLE 423 ON READER SERVICE CARD

# OrgPlus Puts Personnel in Order

PC HANDS ON

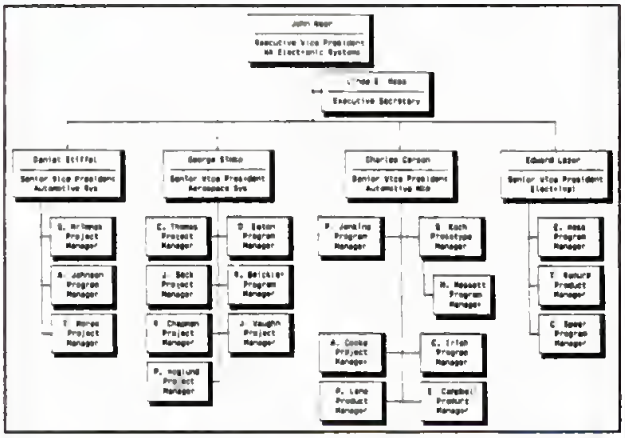
BY BILL HOWARD

*OrgPlus* does one thing: it builds organizational charts with considerably more speed than you could by hand or with a word processor or drawing program.

Like its year-old predecessor *Org*, *OrgPlus* allows you to construct an organizational chart with as many as 350 names on up to 99 levels. Most of the improvements in *OrgPlus* over *Org* reflect more-attractive ways to print the output, with eight box styles and seven chart styles.

*OrgPlus* needs some minor adjustments, though. As it stands, staff-level positions can't have anyone report to them. A department can't have two equals heading it. And you can't view the actual chart, even if you have a graphics monitor, but you can get a cryptic block diagram of the chart on-screen.

*OrgPlus* works with Funk Software's *Sideways*, if you have a copy, to rotate dot matrix printouts 90 degrees (otherwise, you must cut and tape the printout together); Banner Blue should have written its own sideways-printing module.



*Banner Blue Software's* OrgPlus, *invaluable for administrators and managers, builds organizational charts with eight box styles and seven chart styles.*

These drawbacks don't overshadow the fact that *OrgPlus* is one of the few products that can truly pay for itself the first few times you use it.

PC MAGAZINE FACT FILE

*OrgPlus*
Banner Blue Software Inc.
P.O. Box 7865
Fremont, CA 94537
(415) 794-6850
**List Price:** $69.95; upgrade from *Org*, $20.
**Requires:** 256K RAM, printer or plotter, DOS 2.0 or later.
**In Short:** A painless way to build organizational charts. Not copy protected.

CIRCLE 424 ON READER SERVICE CARD

## PASM86

*(continued from page 54)*

Perhaps in response to the SYMDEB debug utility included with MASM, Version 4.0, PASM86, Version 2.0, has a nonsymbolic version of its own powerful PFix screen debugger. PASM86 also has a series of powerful programming aids, including a cross-reference generator, a dump utility, and a special version of the assembler (LPASM) capable of assembling source files that have symbol tables too large for other assemblers.

PASM86 comes on two floppy disks with documentation and toll-free customer support. Registered owners of Version 1.0x can upgrade for free; others must pay $195.

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All modules can post to multiple profit centers
Fully integrated with single source entry
Date sensitive user-defined fiscal calendar
User defined financial reports
User can categorize Accounts Receivable, Vendors, Payroll & Inventory by user defined type
User can design checks, invoices, statements and W-2s
User defined chart of accounts, account numbers and stock numbers up to 15 alphanumerics

**GENERAL LEDGER**
Allows for multi-company ledgers
Unlimited multi-level accounts for departmentalized reporting
Allows daily automatic posting to appropriate accounts
Allows recurring journal entries
User can process transactions two periods into next year
Unlimited number of accounts
Up to 10 year account history
Allows budgeting

**ACCOUNTS RECEIVABLE**
Open invoice and/or balance forward
Allows unapplied payments and multi-company accounts receivable
Handles credit limits, collection status and payment discounts
Supports partial payments and finance charges
Allows unapplied credit memos
Up to 5 user-defined aging periods
Customized text on user-designed statements
Mailing labels and reports with 7 different sorts.

**INVENTORY**
Supports LIFO, FIFO, weighted average or standard cost
Supports markup, margin or list
Allows up to 4 places to right of decimal for units, cost & price
Supports any unit of measure
Supports quantity price breaks

**SALES INVOICING**
Supports service or product oriented businesses
User defined tax tables, including multiple sales taxes
User defined sales discount tables
Prints packing slips
Prints immediate invoices if needed
Alerts user to customer exceeding credit limit.
Sales History Reports
Customized text on user-designed invoices
Automatic updating of inventory daily
Prints sales journals
Allows return credit memos
Interfaces with General Ledger, Accounts Receivable & Inventory.

**ACCOUNTS PAYABLE**
Can post to 200 general ledger expense accounts per invoice
Automatically updates inventory and general ledger daily
Automatically prepares payments
Supports partial payments and handwritten checks
Supports prepaid expenses and future liabilities
Processes credit and debit memos
Computes discounts and records discounts taken

**PAYROLL**
Generates automatic payroll
Automatically posts to General Ledger and Accounts Payable
Provides up to 15 user-defined rates
Allows post facto payroll
Allows distribution of payroll expenses to user-defined departments
Benefits and deductions are calculated on fixed amounts, hourly amounts, percentage of gross or variable
Allows additions to gross which may be taxable, nontaxable, or partially taxed
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All tax tables easily updated by the user
Handles payroll draws, per diem pay, contract and piece work, hourly and salary
Handles tip accounting
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**HARD DISK REQUIRED.**

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CIRCLE 175 ON READER SERVICE CARD

■ FROM THE EDITOR'S SCREEN ■ BILL MACHRONE

# OXYMORON ALERT

*Contradictions abound in the personal computer industry. Sometimes we have to check our assumptions at the door and accept positive change.*

What's your favorite oxymoron? Military intelligence? Postal service? Or how about the RS-232 standard?

There's something that touches the human spirit when we're confronted with a humorous, inherent contradiction in terms. Until today I would have said that "interesting accounting software" is an oxymoron, too.

Accounting is that ubiquitous application that users love to hate and computer magazines love to ignore. Never mind that software manufacturers, retailers, VARs, and accounting firms are making a bundle selling and servicing accounting installations. Never mind that accounting is the original business computer application. Never mind that computerized accounting is the only way to deal with the morass of laws, rules, and regulations that businesses of all sizes face.

Accounting is boring, right? The only way to make it more boring is to computerize it. Or so you thought.

**NEW WAVE ACCOUNTING** I've just seen *NewViews* from Q. W. Page Associates, a Toronto firm. And unless I miss my guess, accounting software will never be the same. The developers of *NewViews* threw away all the time-honored assumptions about accounting software and came up with a unique—and better—way of doing it.

First off, they disposed of the idea of separate modules for accounts receivable and payable, general ledger, and so forth. One master program does everything. It's built around a hierarchical database model that starts at a menu selection screen and ends at transaction details. Each higher level of the database is built upon the preceding level's records. Each line that you see on a screen expands into a window containing the supporting transactions, records, or calculations, until you get down to the most elemental transactions.

Not only does every level have the exact same command structure, but there are five user-interface models to choose from: Ctrl-key (*WordStar*), Slash-key (*1-2-3*), Alt-key, pull-down, and mouse. Truly something for everyone. Better yet, it windows onto various portions of the database simultaneously. Best of all, it's real time. You add a transaction and the summaries or totals to which it applies are updated instantly. It's the accounting version of a 7-Eleven store: it never closes. Whatever it says as of your particular date of interest is a closing balance.

Illustration: Andrea Geller

**ACCOUNTING IS BATCH** Now wait just a flimflam minute, all you traditionalists are objecting. Accounting is inherently batch. You apply a group of transactions by date, then summarize periodically for reporting. That way you have audit trails, batch totals, and all the other stuff you need to ensure auditability. I mean, that's the way accounting works, right?

Sure, if you don't mind waiting until the end of the month to find out if you're losing your shirt. The alacrity with which *NewViews* changes its view of your business's finances makes its name particularly apt. Of course it has audit trails and password protection of functions and modules so that you can ensure its integrity. In fact, it even divides its transaction audits and purge audits into two separate trails.

Oh, yes. And *NewViews* is written in assembler. You know where I stand on this issue: speed and functionality for the end user above all and the maintenance programmer be damned. Besides, properly written assembly language isn't any more difficult to maintain than a high-level language; it just takes longer.

But this isn't a product review. This is a celebration of the future, a revel in the end of stodgy programs. Good ideas are contagious, and *NewViews* is sure to be copied and improved upon. Just because an application is mundane or commonplace doesn't mean that its computerization has to be stultifying. *NewViews* is full of lively features, such as *Paradox*-like screen displays, complete with lockable and side-scrollable columns. It also has a BASIC-like procedural language, and simple but

## ■ FROM THE EDITOR'S SCREEN

powerful custom forms generation. If this kind of thinking works for accounting, consider the potential for all those dental-practice systems, time and billing programs, and other vertical market packages. One of the biggest obstacles to the more-widespread use of vertical market packages is the need for customization. A program with built-in forms generation and a procedural language is ideal.

**VERTICAL BLOCKBUSTER** Speaking of vertical packages, we're planning a single-topic issue next year on business-management software. That means typical *PC Magazine* treatment, including benchmark tests and testing scripts. We'll look at the top accounting programs (of which *New-Views* should be an important player), maybe run a year or two's data through them. We'll have a major accounting firm review the results and verify our findings.

Other vertical packages deserve the same treatment. Which would you like to see us attack? Point of sale? Lead tracking and sales management? Time and billing programs? Inventory control? Which ones and why? Let me know via letter or MCI Mail.

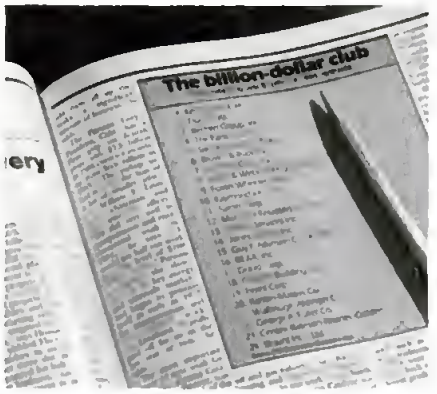
Actually, we haven't done too badly by accounting software. For the last couple of years, we've been running The Price Waterhouse Report. We've relied on the expert opinions of Price Waterhouse partner G. William Dauphinais and his cohorts as they checked out major and some not-so-major accounting packages. These stand-alone reviews were adequate for their time. Now it's time for our accounting reviews to become comparative, like the rest of *PC Magazine*'s reviews.

The last time I got this excited about accounting software was about 7 years ago, when I helped sell a $250,000 custom mainframe payroll system to a large corporation for my employer, a consulting firm. Things have changed a lot since then, mostly for the better.

That old dinosaur was several hundred thousand lines of COBOL code, not buggy, but touchy all the same. It required constant supervision and frequent updates and patches. Of course, it could produce paychecks for anyone from itinerant cotton pickers to commissioned salespeople, in a hundred different companies with a thousand different deduction codes. In a sense, it ran on a personal computer—it took nearly the dedicated capacity of IBM's biggest machines to process the big jobs.

Interactivity wasn't an issue. We thought on-screen simulation of a keypunch machine was pretty nifty.

But that was yesterday. Today, personal computers are the lifeblood of small- and medium-sized business accounting. Tomorrow, they'll even be fun to use.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Source: ENR Construction Economics Dept., *Engineering News-Record*. Issue Date: April 18, 1985.

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# HOW FAST CAN SOMETHING CHANGE THE WAY YOU THINK?

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*THE NEW YORK TIMES*

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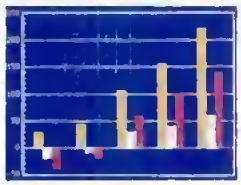
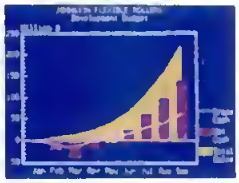


and press ENTER to see them as a simple graph.



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Look how easily and quickly Graph-in-the-Box makes instant graphs in all your programs.

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Instant graphs give instant insight and instant analysis to all the work you do. But don't take our word for it, listen to Personal Computing's rave review:

"Graph-in-the-Box is a serious business tool. With it, you can quickly turn a table of numbers into a graph, regardless of whether the numbers reside in a word processing file, spreadsheet, data base or any other application program. And you can save and print the graph—all without exiting your main application . . . But watch out—the program is so much fun to work with that you might start graphing every set of numbers in sight."

*Michael Antonoff*

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*Computer Retail News*
*Monday, July 7, 1986*

The newest generation of personal computers are designed and manufactured by ADVANCED LOGIC RESEARCH, INC. Heir to all the best traits of its ancestors, the PC2/286 series of personal computers possess total compatibility to past and current hardware and software achievements.

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Like all products in the ALR line, the PC2/286 is born with enhancements and the latest technology available. THE NEXT GENERATION has speed and power equal to that of the AT™, is as small as the XT™, but the complete system (including graphics video card and high resolution monitor) costs less than both! How? Smarter design! Like we've always said ALR doesn't design products without improving them beyond what our competition offers.

Smarter design, as well as being superior, is less expensive to manufacture so you pay less.

We've incorporated all the knowledge that the past successes and failures of big manufacturers have afforded and used it to make a better product.

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The evolutionary PC2/286 brings the power of 80286 (AT) technology into a price range that until now has been the exclusive domain of the PCs. The PC2/286 is destined to be the new standard in a rapidly changing marketplace and is designed to meet the ever increasing needs of today's users.

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CIRCLE 52 ON READER SERVICE CARD

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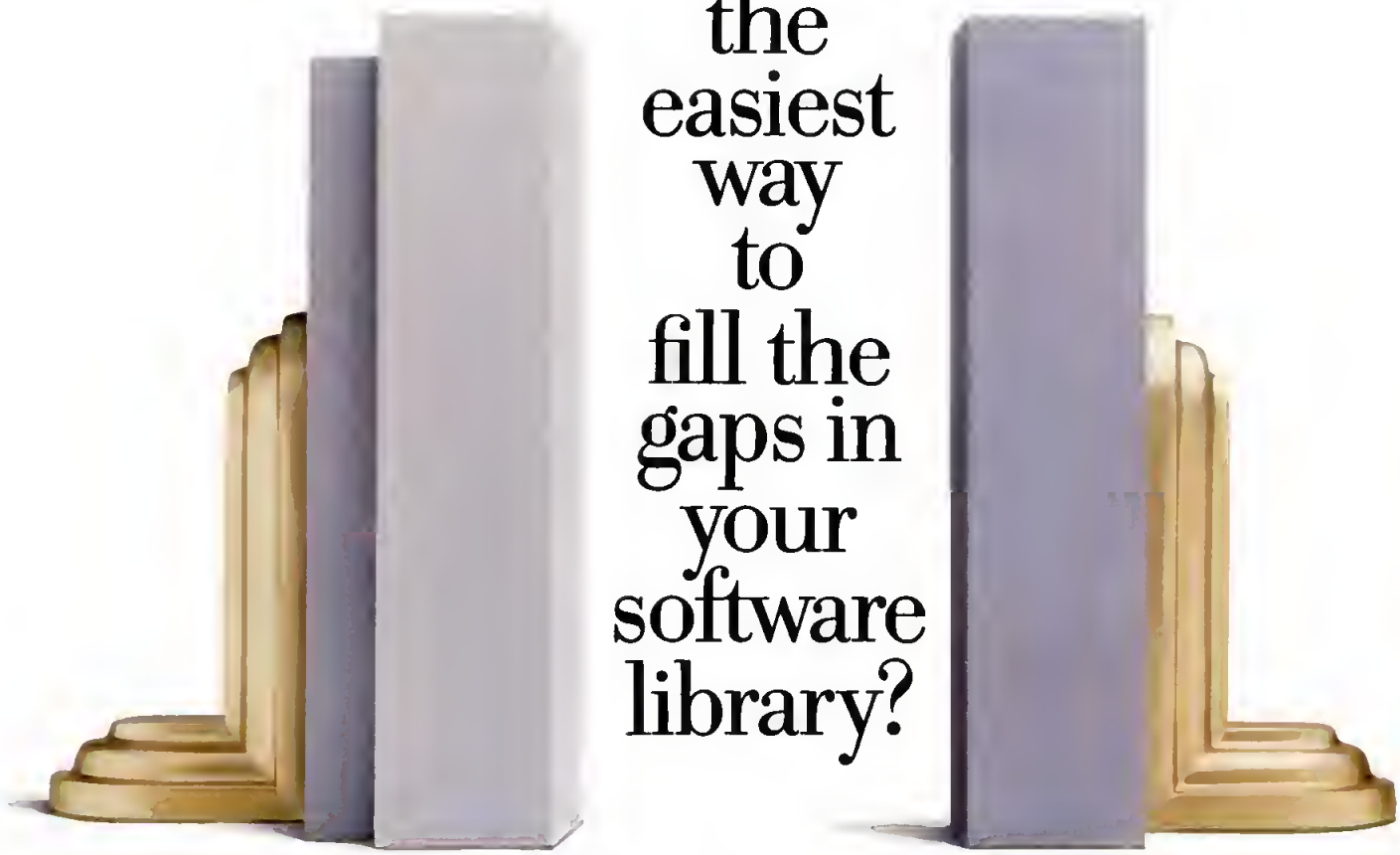
# What's the easiest way to fill the gaps in your software library?



# With some Assistants

If you're a perfectly normal PC user, beneath your well-mannered exterior beats a heart that's passionately devoted to two or three programs.

You know them, you love them, you'll never leave them.

Yet somehow, alongside your trusty spreadsheet, word processor or data base, you know a few others would help.

If only you had the time, or money, or both, to invest in them.

Well, you do.

The IBM Assistant Series makes it easy for you to expand your library.

They're easy to buy, easy to learn, and easy to remember how to use.

Most retail for below $195. Everything is in plain English and makes plain sense. Help screens and pop-up menus reduce headscratching even for occasional users.

And there's an IBM Assistant for just about every job IBM PCs are doing these days, including some your favorite programs probably can't do.

For managing information, there's *Filing Assistant*,™ a highly flexible data base program, *Reporting Assistant*,™ for arranging your data in handsome documents, and *Document Retrieval Assistant*,™ for digging out text files whose names you've forgotten.

For writing, there's *Writing Assistant*,™ a word processing program so logical that even numbers people like it, and new *DisplayWrite Assistant*,™ which lets your PC exchange words with other IBM office systems.

*Planning Assistant*™ makes number

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# from IBM.

crunching easier by replacing complex formulas with plain language commands. It's ideal if you need a spreadsheet sometimes, or all the time.

*Graphing Assistant*™ turns numbers into pie charts, bar charts and line graphs, while *Drawing Assistant*™ turns your PC into a colorful sketchpad for livening up sales presentations or invitations to the company picnic.

For juggling schedules and deadlines, *Project Assistant*™ will help keep you on top of things, and on time.

*Mainframe Communication Assistant*™ helps link your PC to other PCs, to mainframes and subscription data services. *Voice/Phone Assistant*™ sends recorded messages, and lets you call your PC from touch-tone phones.

The Assistants can also communicate in another helpful way: with each other. They're designed to swap information so that one program's talents can magnify another's.

But no matter how you use them, separately or as a team, you'll find that they also complement the software you have now.

To learn more about the IBM Assistant Series, visit an Authorized IBM PC Dealer. For the one nearest you, and a free brochure, call 1-800-447-4700. In Alaska, call 1-800-447-0890; in Canada, 1-800-465-6600.

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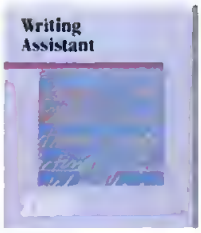
# The Assistant Series from IBM.




*IBM Writing Assistant*™ does everything from memos to manuscripts, has a built-in spell checker and synonym finder, offers various format options, prints out what you see on the screen, and accepts both graphics and numbers from other Assistant programs.

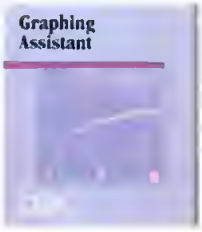
*IBM DisplayWrite Assistant*™ is a word processor that's part of the IBM DisplayWrite series, so it can exchange information with other IBM PCs, minis and mainframes. It also accepts files from other Assistant programs, plus Lotus 1-2-3, dBase II* and more.

*IBM Filing Assistant*™ can store and sort from few to thousands of records, up to 32 pages long with 100 fields per page. The data can be transferred to most other Assistant programs. Even performs math calculations. File formats are highly tailorable.

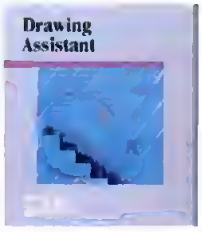
*IBM Reporting Assistant*™ arranges Filing Assistant records in concise formats. It sets and labels up to 20 columns, numbers pages, performs math, alphabetizes or lists records in numerical order, and merges reports with other Assistant Series documents.

*IBM Planning Assistant*™ gives you fast column and row calculations and consolidations without the usual slow learning process. For a total, you enter TOTAL, not C21+D21+E21+F21, etc. Works as a team with Filing, Graphing and Writing Assistants, plus others.

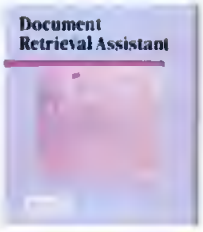
*IBM Project Assistant*™ simplifies complex projects by creating automated "Gantt" bar charts. It can assign individuals or teams to up to 250 separate tasks. Helps you set and track deadlines, and simplifies rescheduling one operation in response to another.



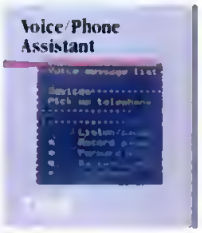

*IBM Graphing Assistant*™ takes numbers from the keyboard or directly from IBM Filing or Planning Assistant and creates pie charts, bar charts or line graphs that can be included in documents prepared by Writing, Reporting or DisplayWrite Assistant.



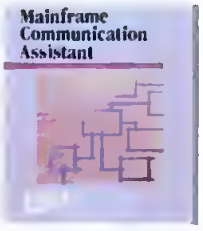

*IBM Drawing Assistant*™ lets you make colorful illustrations, either free-form or with circles or boxes, etc. You can zoom in to retouch details, create "airbrush" effects, add text in several typestyles, then transfer the image for printing in documents.




*IBM Document Retrieval Assistant*™ is for when you have more files than you can remember. It searches for key words that might be in the file you want, then shows you a list of appropriate file names. Works with most Assistant programs plus many others.




*IBM Voice/Phone Assistant*™ turns a properly equipped IBM PC† into a sophisticated phone answering service. Leaves general messages plus "private" ones for special callers and lets you call in (and make recordings) from any touch-tone phone.




*IBM Mainframe Communication Assistant*™ enables a well-connected IBM PC to exchange information with mainframes, other PCs and data services, from office or home. And you don't need high-level technical expertise to make it work. Commands are in English.

*IBM Accounting Assistant Series* is a separate family of integrated programs that give small business a big edge. All the important accounting functions are included, and sampler sections help you get going quickly.

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■ JOHN C. DVORAK

# THE ART OF DISINFORMATION

*Despite the smoke screen, if you keep in mind a few simple rules about IBM's modus operandi, you can dope out the style—if not the substance—of its next move.*

*Disinformation* is a word popularized by author/editor Arnaud de Borchgrave to describe carefully selected information purposefully provided to confuse an enemy. The masters of disinformation are the Soviets, says de Borchgrave. I don't think de Borchgrave has ever studied IBM, though. Surely Big Red learned its techniques from Big Blue.

Disinformation isn't the simple telling of a lie for the purpose of deception. Indeed, there may be no lies told. Disinformation is information strewn out in such a way that the seeker of truth is left wandering the backwoods of reality, mumbling to himself.

The goal of disinformation is the fiendish manipulation of thought and opinion. It has supplanted old-fashioned propaganda. (Ad men take note!) The Soviets use it to convince us that they have nothing to do with world unrest and that their foray into Afghanistan is a peacekeeping good-guy mission. IBM (which I hate to compare to the Soviets or the KGB) mostly uses disinformation to disarm competitive strategists who try to outwit IBM.

**SUCKER'S GAME** It's a sucker's game, though, because outthinking IBM is not hard to do. Just remember that IBM never does anything spectacular or outrageous. Its moves are logical and plodding.

IBM must create a bogeyman image lest the company be predictable to all and possibly considered a laughingstock. Only a few observers (this magazine has a monopoly on them) see through this smoke screen with any consistency.

Unfortunately, more common by far is a Chicken Little–like mentality, determined to ignore the facts. These people are like stock market bulls who illogically think the market will go up forever. They find it interesting to ruminate (and essentially fret) over how IBM is going to do something outrageous or daring. They always conclude that IBM is about to blow everyone away. This plays right into IBM's grand scheme of disinformation.

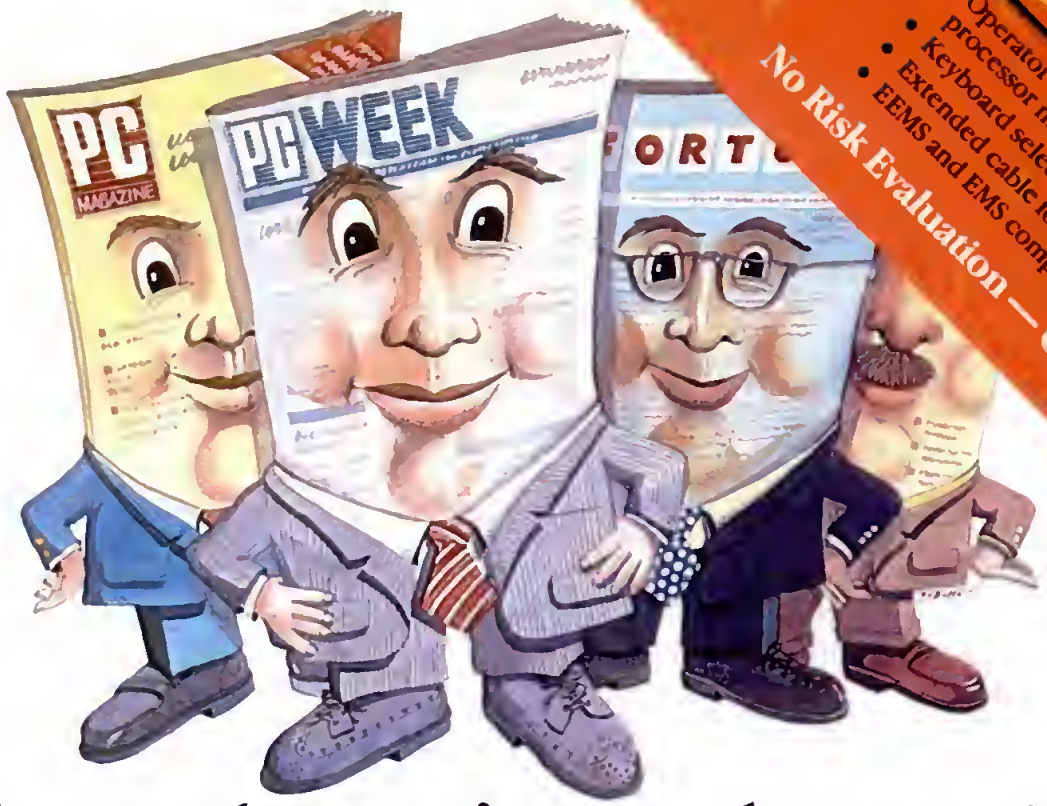
Thanks to skittish columnists (many of whom can be led to believe anything) and disinformation specialists duped or bought by IBM to spread this garbage, we end up with a barrage of bunk. Combine this with the IBM policy of multiple development, whereby two or three separate teams will work on the same project at once, each with its own leaks. The result: we get what IBM wants us to have—a terribly blurry picture of reality.

Examples abound. The most outrageous surfaced in a weekly trade magazine. A reporter there is certain that the new IBM line contains an on-board PGA (Professional Graphics Adapter). This certainty flies in the face of IBM's near abandonment of the PGA. Worse still, in the same magazine Microsoft had a huge ad begging for software designers for some secretive new software. The ad ended with this emphasis: "Extensive EGA experience desirable." Does this tell you something about an on-board PGA graphics display?

So let's just remember that IBM is consistently unspectacular and we can avoid the obvious blunders. Besides unspectacular products, there is one other curious consistency. While IBM never pushes technology to the limit, it does do a couple of noteworthy things. First of all, it goes with the "best" technology (or what it thinks is the best technology). By best I mean reliable, proven, and available from multiple sources. This usually means middle-performing products. Not as fast as they could be—ever! This rules out rumors about a 24-MHz AT 386, as far as I'm concerned.

**SOMETHING SCREWY** Finally, IBM always does something screwy with its new products. These gimmicks are, I'm sure, Armonk's idea of "whizbang." Examples are the infrared keyboard on the PC*jr*, the pop-up disk drives on the Convertible, the DB-9 connector on the AT. Stuff like that. Expect a similar oddball element in the new machines. Don't expect much more.

Illustration: Andrea Geller

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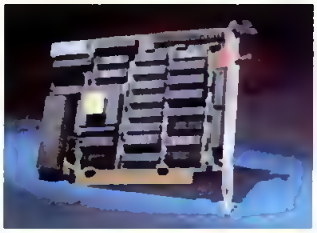

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■ JOHN C. DVORAK

# INSIDE TRACK

*Out of IBM's tangled web comes some spectacularly screwy speculation about its next machine.*

It's months like this that make it easy to write a gossip column. Dozens of fellows have called me with "exact details" of the **upcoming IBM 80386 machine** (see related essay). As I've said before, most of this stuff is **bunk**, but worth repeating. Let's make this the *last* 80386 speculation column.

One thing surely worth mentioning is an **actual date** a fellow discovered for the rollout—January 13 (or was it 14?). It's possible, I suppose.

I've heard details of **three or four distinct machines.** The funniest is essentially an AT box with an **8-MHz 386 chip**. What a groaner that would be. Another laughable rumor is that IBM is secretly working with **Compaq** to somehow test the waters for an 80386. That will be the day.

Someone else claims to have seen an expensive 80386 Sun-like workstation with an **entirely different bus.** Finally one guy has seen a believable 16-MHz machine with a bus detached from the main PC board (which is surface mounted and can't be flexed). There are two 8-bit slots, two 16-bit slots, and two 32-bit slots and maybe two short 8-bit slots in that one. Another guy saw the same machine with no 8-bit slots.

Gee, it sounds like there are a lot of **oddball prototypes** out there, huh? The only consistent theme is that all of these machines are described as having an **EGA, ports, and both disk controllers** on the main board.

Most observers will be surprised by a January announcement of this thing. Word has it that IBM is still **bickering** internally over the impact of an 80386 machine on its product line. The specific concern is over the impact on the minicomputers. Many think that the **System/38** is only good for a few more years. So who cares? The same types say it will **take more pep** than this 386 box to have an impact on the System/38. As this column tries to emphasize, it takes more than mere processor MIPS to qualify as a mini or mainframe. I/O, I/O, it's off to work we go.

The real **head scratcher** in all this speculation is the exact reason for the development of the **screwball XT 286.** One colleague claims that the machine is just a way to get rid of old 6-MHz Level C 80286 chips. In reality those old chips will run fine at 8 MHz and could have been dropped into either model of the AT. And forget about Level C bugs. This is **meaningless,** too, since all the software written specifically for the 80286 accounts for the bugs and assumes everyone uses this chip.

My first explanation for the development of XT 286 was an inventory theory. IBM supposedly has a **warehouseful** of empty PC boxes. Since the PC and PC-XT are **dead,** the XT 286 in this arcane box may keep the **old and clunky** PC-style box moving. Anyway, I've concluded that inventory isn't the issue. So what is the raison d'être for the existence of the XT 286?

Two things, one of them cosmetic and thematic. First, IBM wanted to introduce its new BMW-style naming scheme: XT 286. Sounds like a bimmer, doesn't it? **Maybe a Mazda.** Whatever the case, it looks as though IBM is going to differentiate its lines into two groups. One group will be earmarked by 5¼-inch floppy disk drives and be the high-end machines targeted to be dropped on the endless desks of Fortune 500 companies (each of which has a mainframe in the basement). The XT line and the AT line will go there with **new BMW-style names.**

Then there are the **clunkers:** the Convertible, the Portable, the **ET**, and who knows what else. These will all go with **3½-inch disks** and be sold more like personal computers and less like terminals.

These are minor issues, though. The second, real reason for the XT 286 may be more subtle, more **diabolical,** more a function of **IBM paranoia.** The XT 286 may be nothing more than a post–beta test machine for the **new AT ROM** to be shipped with the next AT upgrade. Hear this out.

At this writing it seems that there is over **50K of new (and as yet undocumented) code in the XT 286.** The ROM is dated April 1986 and clearly calls itself an AT when disassembled. IBM isn't going to sell many of these machines (another gaff to the inventory theory), but it will sell enough to get important feedback on the new ROM. It's likely that this new ROM is the **rumored super ROM** with *TopView* and multitasking hooks to be used by Advanced DOS 1.0 (to be called A-DOS, as in A-Team, formerly known as DOS 5.0).

We know that **IBM was irked** over its hard disk problems in the AT and other embarrassments like the dumb 128K RAM chips. So the company is understandably paranoid about its reputation. Don't let anyone think differently.

So IBM brings out this **innocuous machine** with little fanfare and no raves. It's a perfect vehicle to check the new ROM. If it has bugs, it isn't going to cause a stir and surely won't draw much attention to itself. When the time comes to roll out the new gunboats, then IBM will have **bulletproofed** the new ROM and will have one less thing to worry about.

Oh yes, **let's not forget the RT** in this tangled web. Where does it fit in? It's sure a risky investment (groan). I say kiss it good-bye. Now you know what RT really stands for—**Real Turkey.**

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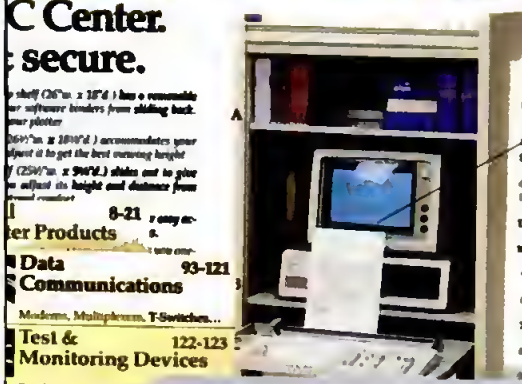


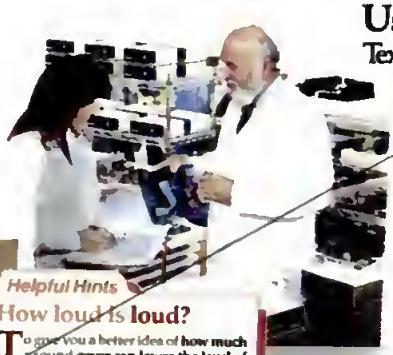

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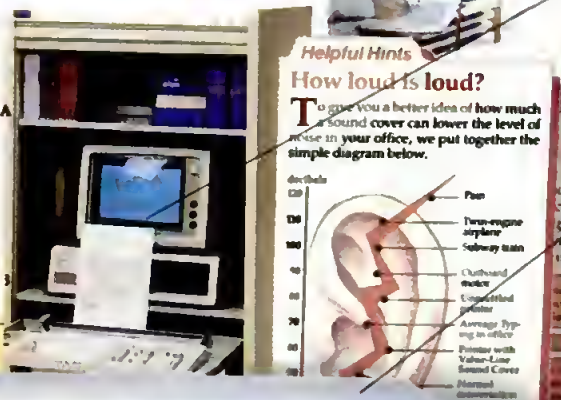


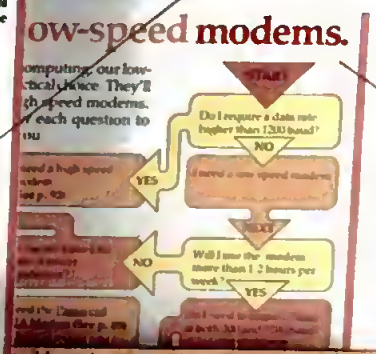


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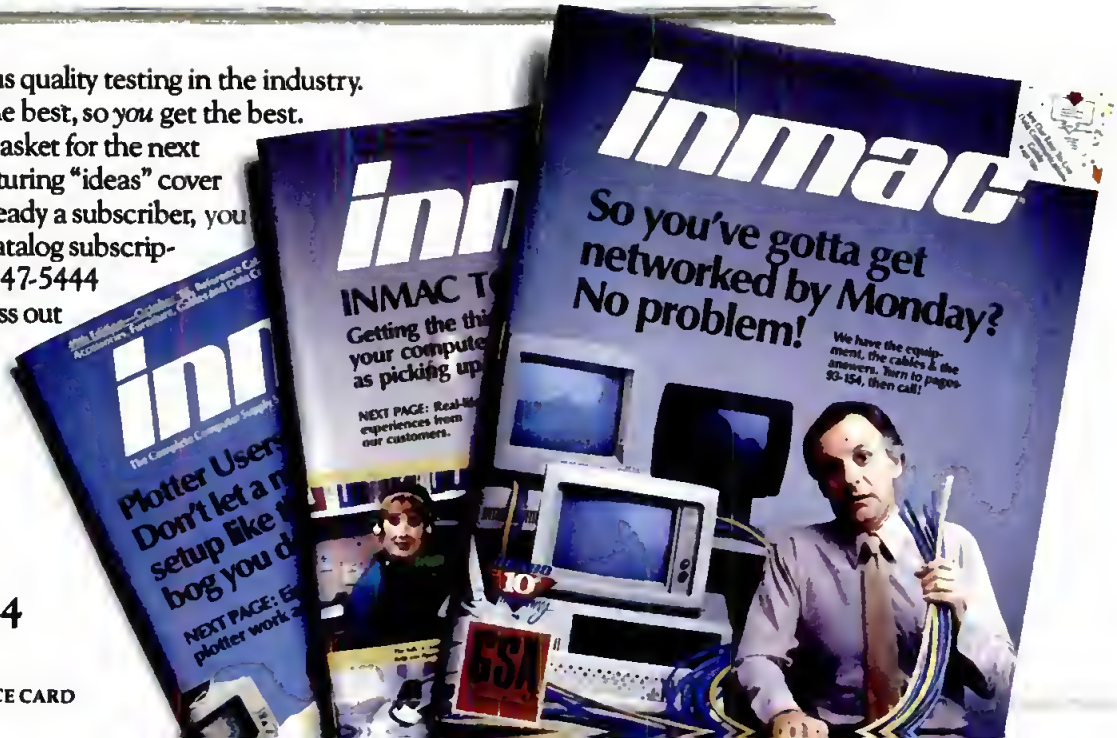


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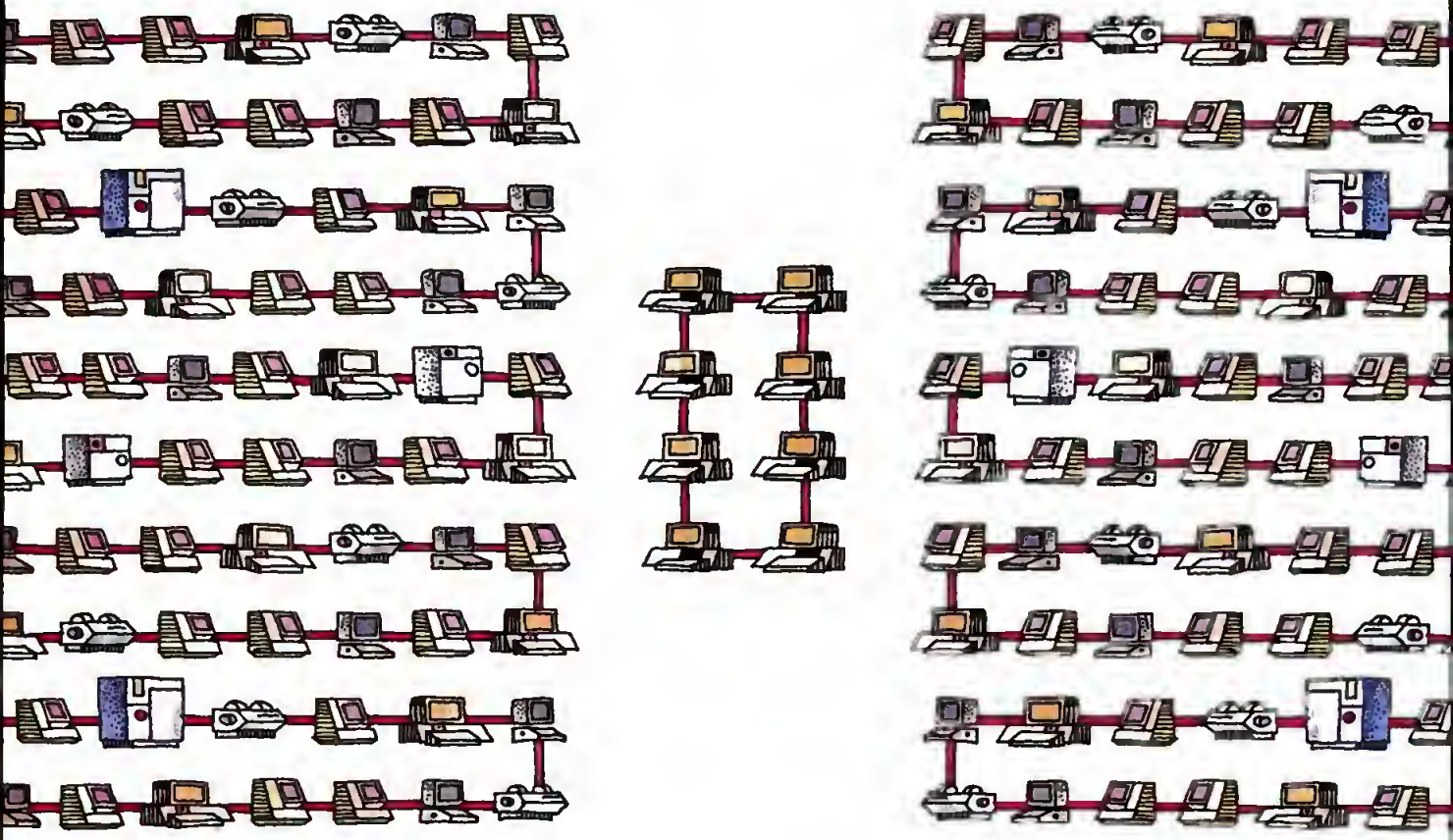

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■ PETER NORTON

# A QUANTUM JUMP IN DESIGNING INTERFACES

*Dan Bricklin does it again. After stunning the world with the first electronic spreadsheet, VisiCalc, he now brings forth Demo, a revolutionary tool for designing program interfaces.*

Every now and then, and quite coincidentally, ongoing developments in a number of independent fields reach fruition simultaneously. Wherever that happens—in machine technology, chemistry, physics, biotechnology, whatever—the result is invariably a quantum jump in the state of the art. I expect 1987 to witness just such an extension of the leading edge of desktop computing.

The advances are building on many fronts, including graphics and displays, amount of usable address space (where order of magnitude increases are called for), and operating systems that are capable of both integrating the power of all these new developments and presenting it to the user and program developer in an efficient manner. But the most important advancement, to my way of thinking, may very well turn out to be one of the simplest: new and better techniques for designing program interfaces.

**QUIRKS AND ECCENTRICITIES** Designing an effective interface is not an easy job. When you've designed and written a program, know it inside and out, understand it better than you do yourself—that is precisely when you are in the worst-possible position to develop a decent interface. You know the quirks and eccentricities far too well to recognize them for what they really are. You rationalize clumsy and inefficient operations as necessary ("You'd understand if you knew the program"); what are obviously bugs become "documented" features.

The problem is clear: the premise is flawed. The time to design the user interface is before the program is written (or at least very early in the design cycle), not after. Surely such an early design won't be static: the capabilities of the program will evolve as it is written, and the interface must change to accommodate them. But having a firm grasp of what the interface should look like and how it should function right from the beginning will go a long way toward guaranteeing that the final program will not just be capable of getting the job done, but of doing it in an efficient, pleasant manner.

With interface design so critical, you'd think there would be a plethora of tools to help the programmer design a good one. Strange to say, up until recently there weren't any.

**ENTER BRICKLIN** Together with Bob Frankston, Dan Bricklin ignited the microcomputer revolution years ago when he presented an unsuspecting world with *VisiCalc*, the first electronic spreadsheet. The concept was a natural for a personal computer, and anyone around at that time looking to get into software publishing could only kick themselves for not thinking of such an "obvious" product.

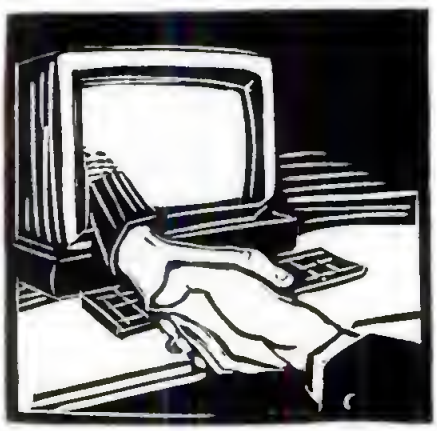

Illustration: Andrea Geller

Dan Bricklin must live perched at the apex of a very high hill in the middle of thunderstorm country, because lightning has struck him again: his new interface design and demo program, *Dan Bricklin's Demo Program*, is to my mind every bit as innovative and revolutionary as *VisiCalc* was. Like *VisiCalc*, it's an "obvious" idea that fills a very real (and very important) need. Also like *VisiCalc*, it breaks new ground: this is not only a new product, it's a new class of product.

Up to now, designing interfaces for PC programs was a time-consuming, expensive, and usually frustrating job, sort of a grown-up version of building castles in the air. Pretend (a good choice of words) you are designing a program's interface, pre-*Demo* era. First you will—here's the "airy" part—imagine what you want the interface to look like.

Now think through using the program (more air): Does it look right, does it feel right? Try to anticipate any problems or awkward operations. Two "sciences," intuition and luck, are very useful at this point.

Now write the code that implements your program and interface, and God help you if you discover the interface is awkward or just plain ugly: redesigning it will probably take longer than redoing that part

of the code that actually does something (are you getting the bias here?). And anyway, who says it's going to be any better the second time? Or the third, or even the fourth? Interface design, I believe, is an art, and if you're not prepared to add more paint or start over from scratch when you've painted yourself into an insufferable corner, you're never going to be a master.

**FANTASY TO REALITY** This is where *Dan Bricklin's Demo Program* comes in. Instead of leaving your castle floating in the air, "imagining," "anticipating," "intuiting," and just plain hoping, *Demo* lets you rapidly create real screens that look just like the ones you imagine—right down to the blinking hardware cursor. And just as important, because you can build virtually any number of screens and move between them based on predetermined criteria (pressing one of a number of predetermined keys, awaiting a time-out, and so on), *Demo* lets you actually get the feel of what a finished program will be like. One member of my team, John Socha, used *Demo* to refine certain parts of the interface of the *Norton Commander*, and I admit that more than once I went through several screens in the *Commander* thinking I was using the real thing, before I realized I was actually in the middle of a very complete and realistic demo.

Believe me, potential interface problems show up very vividly and very quickly when going through screens like this, and *Demo* lets you try out solutions just as quickly.

**HELPFUL HINTS** To help you get a feel for what the program can do, I'll describe some of the tricks I've learned using *Demo*. For those of you intending to use *Demo*, a couple of words about the implementation of the program can save a lot of confusion.

Earlier, I said that *Demo* lets you create a virtually unlimited number of different screens. That was of course poetic license; Bricklin uses the concept of reusable "overlays" to keep down the number of separate screens the program must store (and that you must design).

Having seen *Demo* in use at the office and having breezed quickly through the documentation, when I finally sat down to create screens in *Demo* I assumed I was going to create an overlay or a slide.

Wrong. While the manual doesn't make it clear, there is no functional difference between a slide and an overlay. They are one and the same beast, and the only way they can be differentiated is by the context in which they appear.

Just as with a real slide, you can see through transparent sections of *Demo*

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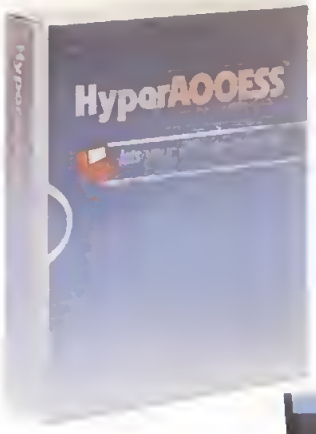


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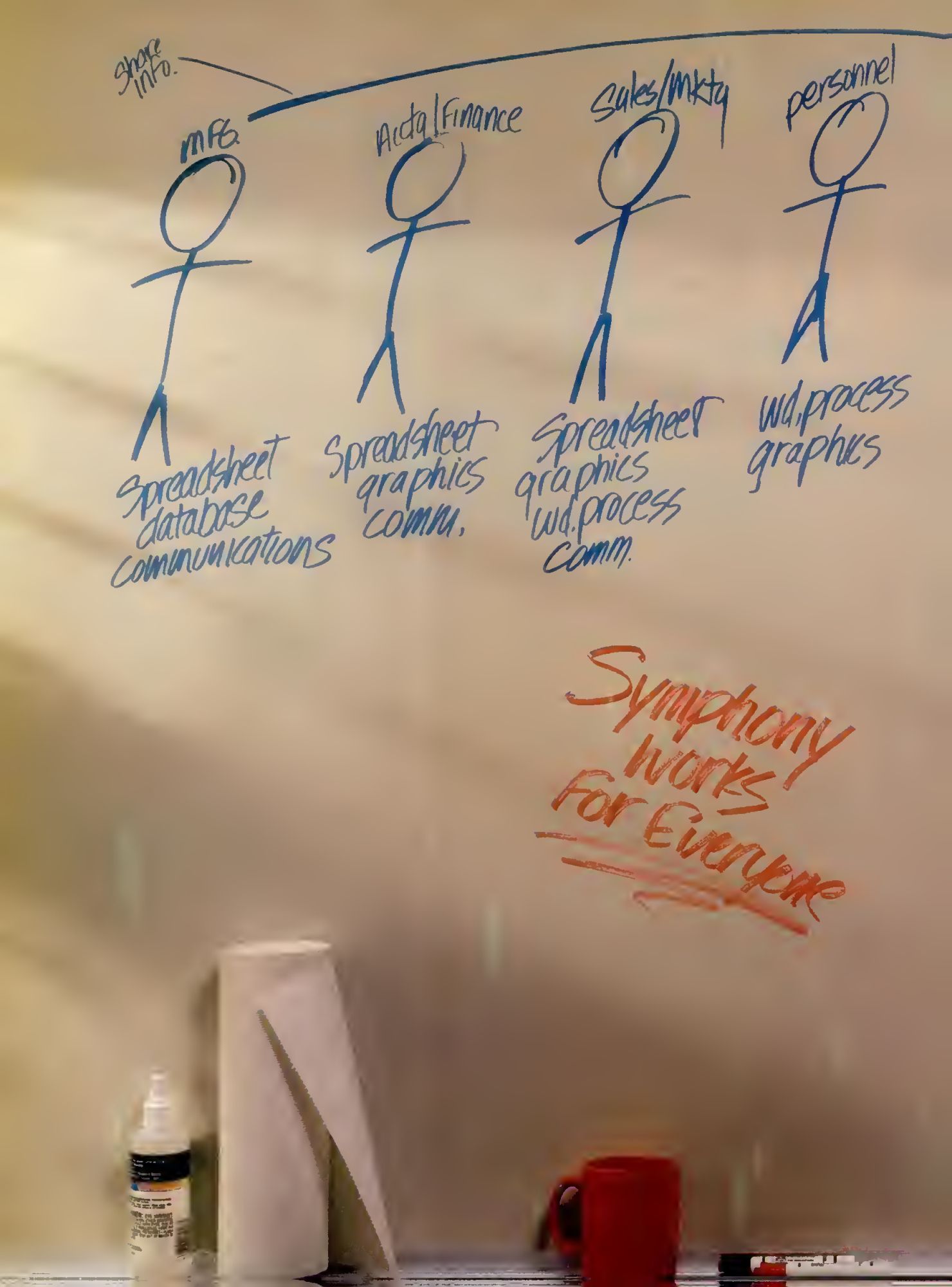
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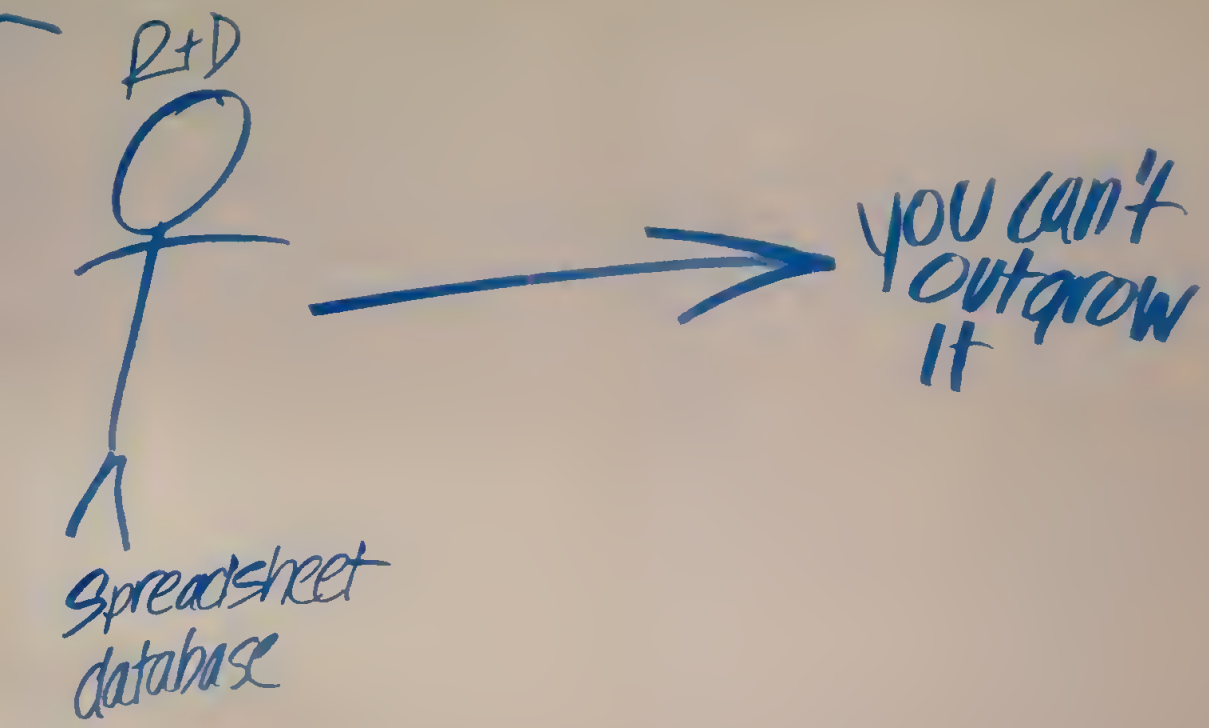


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## ■ PETER NORTON

"slides" to what's underneath. An overlay is simply a slide screen you've created, just like any other; it's an overlay only because you've said it will be automatically placed over (or under) another slide whenever that slide is viewed. (This means that at another time the "overlay" could be a slide, with its own overlays.)

As an example, suppose you're demoing a program with a main menu that appears a number of different times—maybe when the program starts, while text is being entered, and when the program is exited. You'd start by creating four slides—one each for what the screen would look like during startup, text entry, and quitting, plus one more slide that is simply the menu itself (parts of the slide not actually occupied by the menu would be transparent). Let's say you've arranged your slides in that order: Opening, Text Entry, Closing, and Menu. By leafing through your slides before defining any overlays, you would see four separate slides: the screen at opening, at text entry, and at quitting, all without the menu, and finally the fourth slide, the menu by itself.

Now here's the trick. Leaf to the first slide and define an overlay for it: make it the fourth slide, Menu. Use *Demo*'s Overlay command to tell *Demo* that whenever the Opening slide is placed on the projector, Menu will automatically appear above the Opening slide. Menu is now an overlay of the Opening slide, and you'll see the opening screen with a menu on it. (A slide is placed on the projector one of two ways: either you select it manually while developing a slide show, or it is placed on the projector automatically, likely in response to the viewer pressing a certain key while *Demo* is running a show.) You could also define Menu as an overlay for the third slide, the Closing screen, so Menu will also appear with it. Even though Menu is now an overlay to two different slides, it is still a slide in its own right; you could even designate a slide to appear whenever Menu was placed on the projector, in which case Menu would be an overlay to some slides and would itself have overlays.

By now you must have guessed something I discovered: in addition to being a very valuable and efficient tool with very confusing documentation, *Demo* is also a heck of a lot of fun to use. PC

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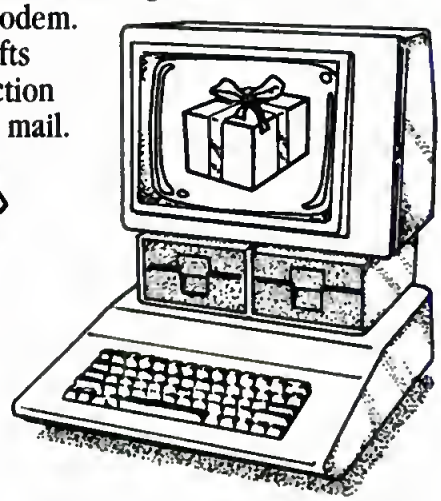

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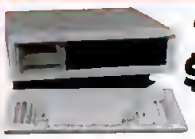

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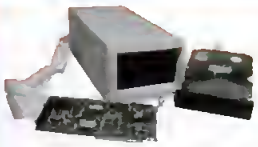

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# DEBUGGING AI MYTHS

*Artificial intelligence has been mired in hype and unrealistic expectations, but expert system and natural-language tools can genuinely make PCs smarter in specific areas.*

The "AI shuck" continues. Or at least, the AI confusion.

Few people who understand what artificial intelligence techniques can do to speed up our work, get better answers, and relieve tedium doubt that AI is going to play a central role in the future of computers.

But today AI is getting mired in confusion, hype, unrealistic expectations, sloppy definitions, and holier-than-thou sniping. That's not doing much to develop the kind of well-informed, receptive universe of computer users we'll need in order to tell the AI industry what we expect from it.

**BAD LABELING** The phrase *artificial intelligence* is itself a lousy place to start. The Brits prefer *intelligent machines*, which comes a lot closer to the reality, but *AI* is likely to stick on this side of the Atlantic. There's nothing artificial at all, of course, about the kind of reasoning AI tools bring to computational tasks: a well-done expert system applies high-order logic to wend its way through a problem toward a high-probability answer.

Expert systems are just a part of the AI world, but they're the easiest-to-understand example of how AI tools can make our lives easier.

Richard Anders, whose company, JuriSoft, has been specializing in intelligent PC software for lawyers, likes the analogy between expert systems and idiot savants.

You remember the phenomenon of the idiot savant from CBS's "60 Minutes" and elsewhere: individuals who have extraordinary abilities in one special area but who may be quite ordinary, or even very limited, in their understanding of the rest of the world.

A common manifestation of the idiot savant syndrome is the child who can perform amazing mathematical feats in his head, usually in an instant—telling on what day of the week June 7, 1421, fell, for example, or extracting a square root from a six-digit number—but who has marginal, or worse, social and language skills.

This is a fine metaphor for an expert system: it knows nothing beyond its special area, but it knows that very, very well. DEC uses an expert system to make sure VAX systems are properly configured, solving an extraordinary maze of memory, storage, power, cabling, and other problems to get the right bits and pieces to the customer's door. That system hasn't the slightest idea what a "VAX" is (nor, for that matter, what a "customer" is), but it's far more accurate than most humans at making sure that the right pieces of the puzzle are fitted together to make a working minicomputer system.

Illustration: Andrea Geller

Sounds good—and it is. So good, unfortunately, that software producers are tempted to claim AI credentials for products far removed from intelligence of any sort.

Last year I got so fed up with the hype surrounding AI, and vendors' tendencies to claim there was AI in just about everything they were doing, that I had some stickers printed that I suggested retailers might put on every new software package that came into the store: "Now! New and Improved—with AI Added!"

But that kind of skepticism can be carried too far, and today's backbiting about what is and isn't legitimately AI, especially in PC software, is getting out of hand.

**IN PLAIN ENGLISH** Natural language interfaces—which allow us to interact with computers in English, a language far more widely understood (if intrinsically clumsier) than any high-level computer language—are important parts of AI, too.

I've often praised and frequently recommend Symantec's *Q&A* to PC users who don't care much about computers but who do need to do some writing, electronic filing, and list management. While *Q&A* has very nice and remarkably easy-to-use word-processing and flat-file database-management modules, the magic in the box resides in *Q&A*'s natural-language Intelligent Assistant module.

The Intelligent Assistant allows users to

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throw very mundane English-language (read: natural language) queries at the *Q&A* database without worrying about field names and syntax. Ask it to "Show me the people here who make more than $30,000 a year, have been here for more than 5 years, and haven't had a raise for 2 years," and it'll come back with a precise computer-lingo redefinition of your question, look up the correct answers, and then present them to you on-screen.

A lot of AI people sniff that *Q&A* doesn't really use much AI. Phooey. While those folks are caught up in theological arguments about LISP versus PROLOG, Symantec's busy helping people get their work done without having to learn computerese.

In business, that's called "delivering value." It's also called "making money."

I suspect the end to the confusion, hype, and litmus tests over the AI-ishness of products isn't going to come from within the AI community but from within the PC community, as the possibilities and limits of AI become better known to PC users and developers.

**TI'S AI CONTRIBUTION** Texas Instruments has done more than any other company to educate people about AI, to popularize it, and to make useful AI tools available at reasonable prices.

■ Texas Instruments has done a lot to educate people about AI and to make AI tools available at reasonable prices.

For some time, TI's offered its *Personal Consultant Plus* expert-system-development package for personal computers. At $3,000, it sounds expensive for a product aimed at developing PC applications—until you look at the few competitive products, which are priced far higher.

At the American Association for Artificial Intelligence meeting in late summer, TI introduced a new *Personal Consultant Easy* version. It accepts fewer rules and has some limitations—but especially at $495, it's a genuinely useful tool for developing real applications that use real AI.

The answer to ending the AI shuck-and-jive isn't to keep counting AI angels on the heads of cosmic pins but to use tools such as TI's to develop realistic expert systems that run on PCs and do real work.

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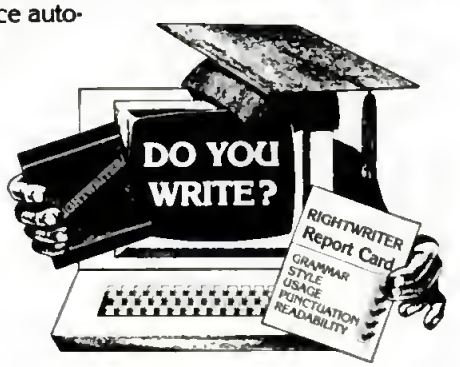


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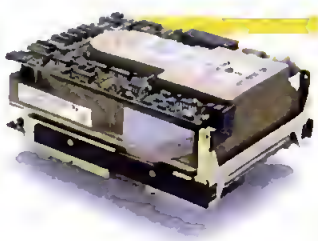

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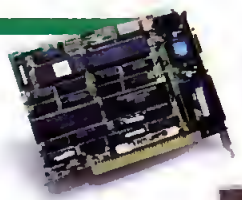

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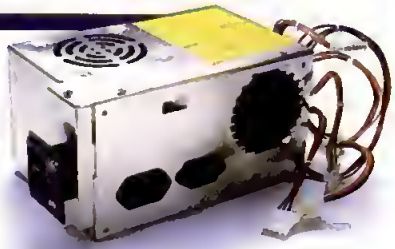

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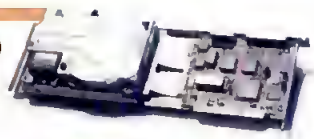

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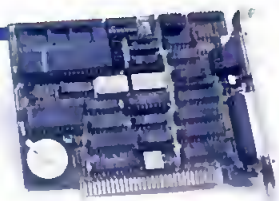

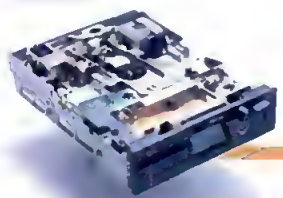

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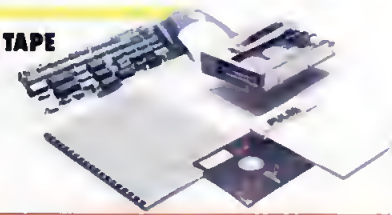

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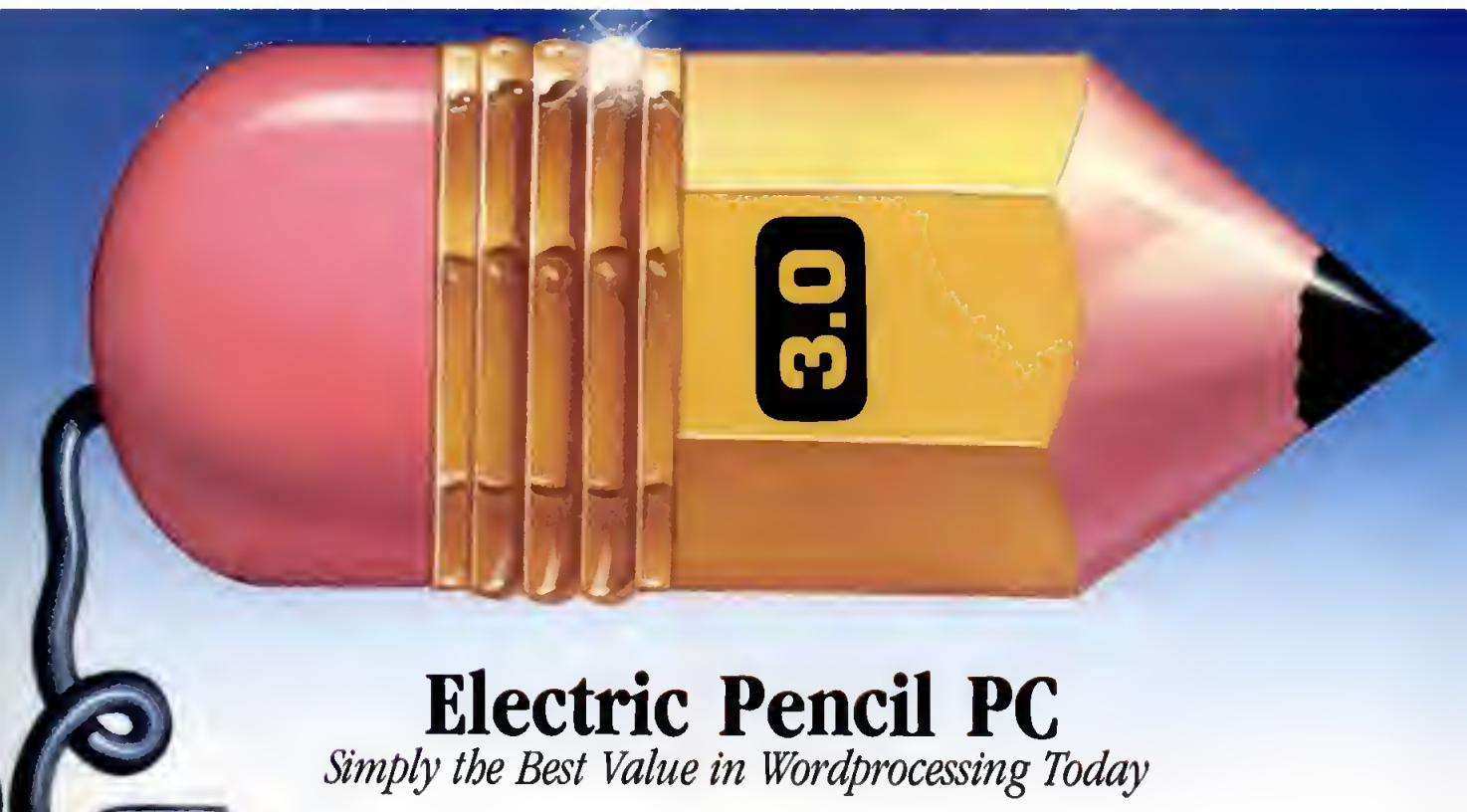


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■ STEPHEN MANES

# UNDERUTILIZATION: NEXT YEAR'S BUZZWORD

*Why do software publishers have the blues? You consumers are just not buying that second software program, that's why. But Victor the Venture Capitalist has a solution.*

"So what's this hot new item you lured me here for?" I asked Victor the Venture Capitalist across the table of a New York restaurant so tony it didn't even have paper napkins.

Victor pointed to the blowfish roe. "Amazing stuff: you'll love it or you'll drop dead. Maybe both."

"Sounds like some of the software you guys put out," I said. "Stop stalling. What's the scoop? A brand new multiuser system?"

Victor just inhaled some more of the fish eggs.

"A new multitasking system?" I pressed.

"Multi, mate?" snorted the Australian native, with that particular note of smugness reserved for successful businessfolk. "Come now. The only multifarious item most microcomputer users get near is their daily multivitamin capsule. No, quite the opposite. You are about to learn about a phenomenon I have just uncovered. Remember, you heard it here first."

"Full credit will be bestowed if appropriate," I allowed.

"Fine. The software business is in the doldrums, right?"

"So we hear."

"Do you know why?"

I shook my head.

**OUT OF THE DOLDRUMS** "Underutilization," Victor declared, and raised his index finger. "Say you're in the gasoline business. Say people decide to use their cars solely to drive to work and back instead of to the mall and the supermarket and their mother-in-law's place and Louie's House of Carp and Filipacchi Falls, the Eighth Wonder of the Wetness World. You, Eddie Exxon, are suddenly in big trouble."

Victor was just getting started. "Say you're in the phone business or the videotape business or the electricity business. You'd be in the soup, wouldn't you, if people never used their phones to schmooze with their friends or never used their VCRs to do anything but tape sumo wrestling matches or never used their ranges to do anything but fix Stovetop Stuffing? And you know what that would represent?"

**SINGLE-USE PCS** I opened my mouth to reply, but Victor shoved his words in edgewise: "Underutilization, my friend. And it's precisely what has happened in the microcomputer business. My informal surveys show that more than half of America's PCs are being used for one thing and one thing only."

"Namely?"

"Doesn't matter. It's not just one person, one computer—it's one computer, one application. Except for a few power users, the only thing people know how to do with their computers is the one thing they learned when they first got their machines. What's more, plenty of these lost souls don't even know there are other applications available."

"Where'd you come up with this?" I wondered.

"A couple of weeks ago in a drugstore. Ran into an old friend of mine. Said she'd been using the PC and word processing software I recommended for more than a year and a half. Couldn't thank me enough. Her writing career is suddenly blossoming. But what was she in the drugstore buying?

A $3.29 pocket calculator, that's what."

I shrugged. "So?"

"So just to make conversation I said something about how nice it is that they're now the size of a credit card and solar-powered so they don't even need batteries. But she said she didn't care because she wasn't going to carry it around with her anyway—she was just going to use it to balance her checkbook. I asked why she didn't get a program to turn her PC into a calculator and a lot more besides."

"Because they cost more than $3.29?"

Victor shook his head. "Because she didn't know there was one. Naturally, I put her onto our little memory-resident favor-

Illustration: Andrea Geller

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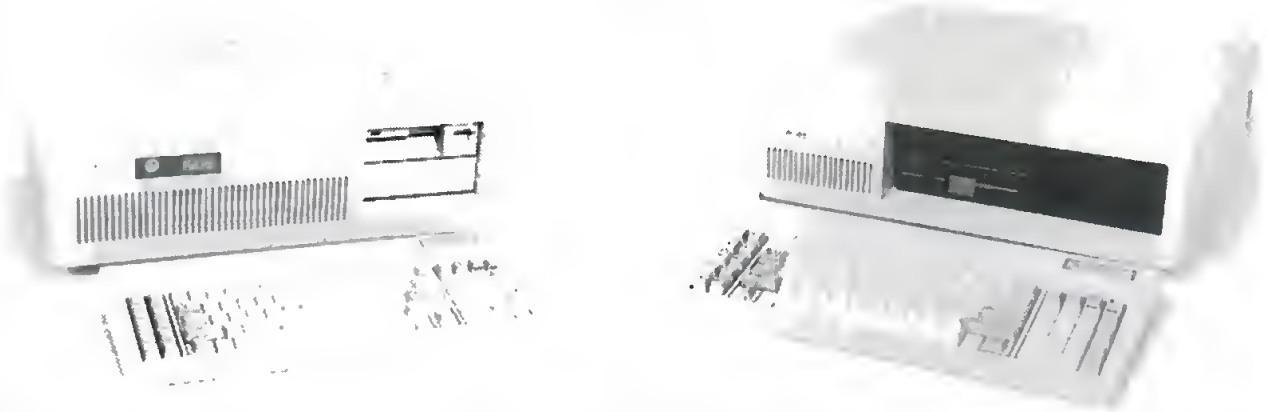

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■ **STEPHEN MANES**

ite. She thanked me and went her way. I rang her up a couple of weeks later to see how she liked it."

"And?"

"She hadn't even bothered investigating it. She'd stuck with the calculator. Said she remembered how long it took her to learn the word processor. She was petrified at the thought of having to go through it all again. And, of course, the software was a bit pricier than the calculator."

Victor pounded his fist on the table. "Well, she's not alone! There are plenty of people who copy file information off the screen by hand because they have no idea how to sort a directory. There are people who paste spreadsheets together because they don't know how to print them sideways. There are fanatics—power users, no less—who have actually devised macros to turn *1-2-3* into a word processor just so they don't have to hassle with a whole new program!"

"Sounds as though you smell business opportunity."

Victor looked manic. "There's a huge untapped market out there! If we could just get people to buy a second program, we could be rich beyond our wildest dreams!" Victor turned somber. "But MicroPro couldn't. Lotus couldn't. Ashton-Tate couldn't. Hell, even Peter Norton couldn't. What will it take?"

"Recreational stuff?" I mused.

"Really! How many people do you know who have the time to learn to land *Flight Simulator* without crashing?"

"Brilliant new applications?"

"Find me the brilliant new people to develop and market them."

"Better, less-intimidating software in the first place?" I suggested.

"How quaintly naive!"

"So what's your solution?"

"We just don't seem to be able to get people to make follow-up purchases no matter what we try. So we're taking a little different approach. We've implemented two new business plans."

"Which are?"

"Plan One: Gouge the hell out of the customer the first time around. After all, it may be our only shot. Tomorrow we introduce our new pricing structure: precisely triple the old one. And that doesn't include our expensive new support package."

"But what if everybody decides to give up on your stuff and go somewhere else?"

"That's where Plan Two comes in. We're hedging our bets. We've just bought out Kalkatronics Co. It's an offshore outfit."

"What kind of software do they make?"

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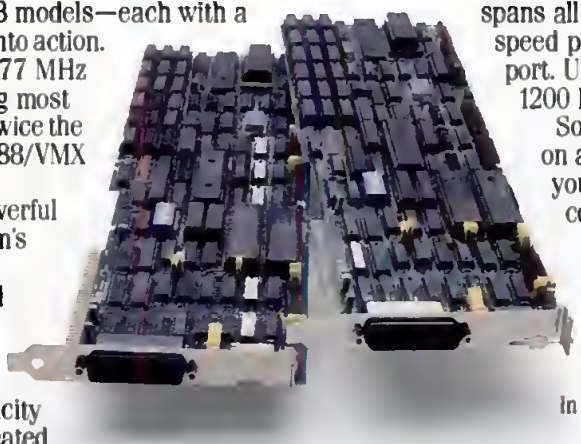

And the board's dual ported memory architecture allows data to pass directly between processors at memory speed—so communications fly through your system.

**Multiple lines and protocols for a multitude of applications.** Adaptable as it is wise, the DCP-88 blends into your comm environment. With up to four serial ports, for example, you can tie to multiple hosts or PCs. Plus, the DCP-88 fully supports asynch, bisynch, SDLC and HDLC protocols so your system's smart enough for any application.

**Supports printers up to 1200 lpm.** The DCP-88 spans all your comm needs, providing high speed printer support via its optional parallel port. Up to 600 lpm on the DCP-88/VM and 1200 lpm on the DCP-88/VMX.

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CIRCLE 362 ON READER SERVICE CARD

# In the new world of the IBM Token-Ring network it's nice to see an old familiar face.

The Token-Ring LAN is a reality. It shouldn't surprise you that IBM® was the company that developed it. It should be equally unsurprising that the technology that best allows the Token-Ring to communicate with the mainframe comes from DCA, the makers of IRMA.™

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■ STEWART ALSOP

# LOSING SLEEP OVER DOS SHELLS

*So many programs are dedicated to making DOS easy for unsophisticated users that we all end up more confused than ever. Why didn't IBM do it right in the first place?*

In case you hadn't noticed, much of the software development effort in the PC industry goes into making software easy to use (what used to be called user friendly). Much of that effort is spent on getting applications to do many of the functions of the operating system, so that you don't need to quit to copy files or delete them. The most visible part of that effort, though, goes into so-called DOS shells: programs that do the same things as the operating system but do them in such a way that dumb users like you and I needn't be troubled by such commands as COPY or FORMAT.

I've been troubled by DOS shells for some time. (The life of a columnist is rough, spending nights awake worrying about DOS shells and user friendliness.) I have a bunch of shells sitting on my software shelves: *The Norton Commander*, the ever-popular *1 DIR*, *Scout*, *XTREE*, not to mention such aggressive shells (or operating environments) as *Microsoft Windows*, *GEM*, *DESQview*, *Mondrian*, and IBM's own *TopView*. I kept thinking that since there are so many of these products, there must be something significant about them. (That's a common malady of industry watchers: they think lots of products must mean that the products are important. Actually, it just means that programmers think they are important, which is an entirely different matter.)

**WHY HIDE DOS?** "Why is it that software developers spend so much of their time writing programs that hide DOS?" I kept asking myself at two in the morning. Then the answer came to me in a blinding flash: because IBM messed up.

It's hard to say that a company that has managed to sell more than 3 million computers in 5 years, that helped create an industry that has sold another 2 million or so compatible computers, and that has set many of the standards for the industry messed up.

But IBM did mess up. In its haste to get a computer on the market, IBM forgot to create a vision of what personal computers should be and how the user should interact with them. Everybody knows the story of how IBM took just a year to put together the first PC, mostly out of other companies' parts: Intel's microprocessor, Microsoft's operating system, Epson's printer, Tandon's disk drives, and so forth. As a strategy, IBM's approach was much heralded as beneficial: it allowed other companies to participate in its success and gave consumers a wide choice.

Illustration, Andrea Geller

**JUG WINES** The PC is to personal computers what 1-liter bottles of Gallo red wine are to wines: sort of an everyman's computer. Like Gallo wine, the PC is widely available and reasonably priced, and it's easy to understand. But it makes no statement. As a result, every programmer who comes along is allowed to believe that he has a better user interface, whether he is trying to make an application easier to understand or thinks he can make the computer itself easier.

One programmer thinks it's better that we dumb users get an easy way to see how our directories are structured so we know where we are and where our files are. Another thinks we should get an easy way to make batch files that look like pop-up menus. Another thinks DOS stinks and adds new commands that let us do things to our files that DOS never intended. Yet another believes we shouldn't ever see DOS and gives us a way to switch between programs without issuing commands.

As far as I'm concerned, they are all wrong. They're wrong because none of them can decide for me what's best. And I don't have time to remember which shell gives me which features for each situation I might run into. And the net result is that I end up sticking with DOS, unable to remember where I am on the hard disk, unable to remember which batch command does what I really want to do, and unable to remember the correct phrasing for some DOS commands.

My real question is, "Where does IBM stand in all this debate about what's best for us dumb users?" It's been 5 years now

■ **STEWART ALSOP**

since the PC was introduced, plenty of time for IBM to make up its mind about how it feels. And yet all we've gotten from the company is a 256K program called *TopView* that barely manages to give us more features than the operating system itself, takes up nearly half our available memory to do so, and supports some weird bank-switching scheme for using extended memory that no applications support.

**THREE GOALS** Earlier this year, the executive in charge of IBM's personal computer division (called Entry Systems Division, which probably means that IBM thinks PCs are just a good way to get people started on their way to an IBM mainframe) said that the company had three primary objectives. The first two were to fix the operating system to allow 286-based PCs to use more than 640K of memory and to allow multitasking. The third was to develop a graphical user interface for its computers.

In the 9 months since then, the company has introduced three new computers—the RT PC, the PC Convertible, and the PC-XT Model 286—and a slightly improved version of *TopView*, but no graphical interface. So what gives? What does IBM stand for when it comes to computers? IBM is the biggest computer company

■ Like Gallo wine, the PC is widely available, reasonably priced, and easy to understand.

in the world. It is the most profitable company in the country. I for one would like to see it stand up and be counted. That way I wouldn't have to lie awake at night worrying about DOS shells.

What really worries me is that IBM has already made its statement about personal computers: that it believes DOS is the ultimate way for dumb users to deal with a computer. Personal computers are, after all, merely a new and intriguing way to make terminals for mainframe computers. Indeed, personal computers are such neat terminals that they increase demand for mainframe processing power, thereby creating a bigger market for the big computers. And you certainly wouldn't want to stick a lot of code in the PC's memory that would just get in the way of hooking into a mainframe. I'm not just lying awake anymore; now I'm beginning to have nightmares about DOS shells. PC

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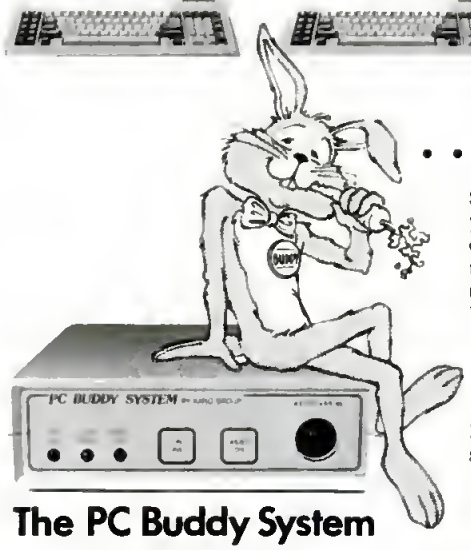


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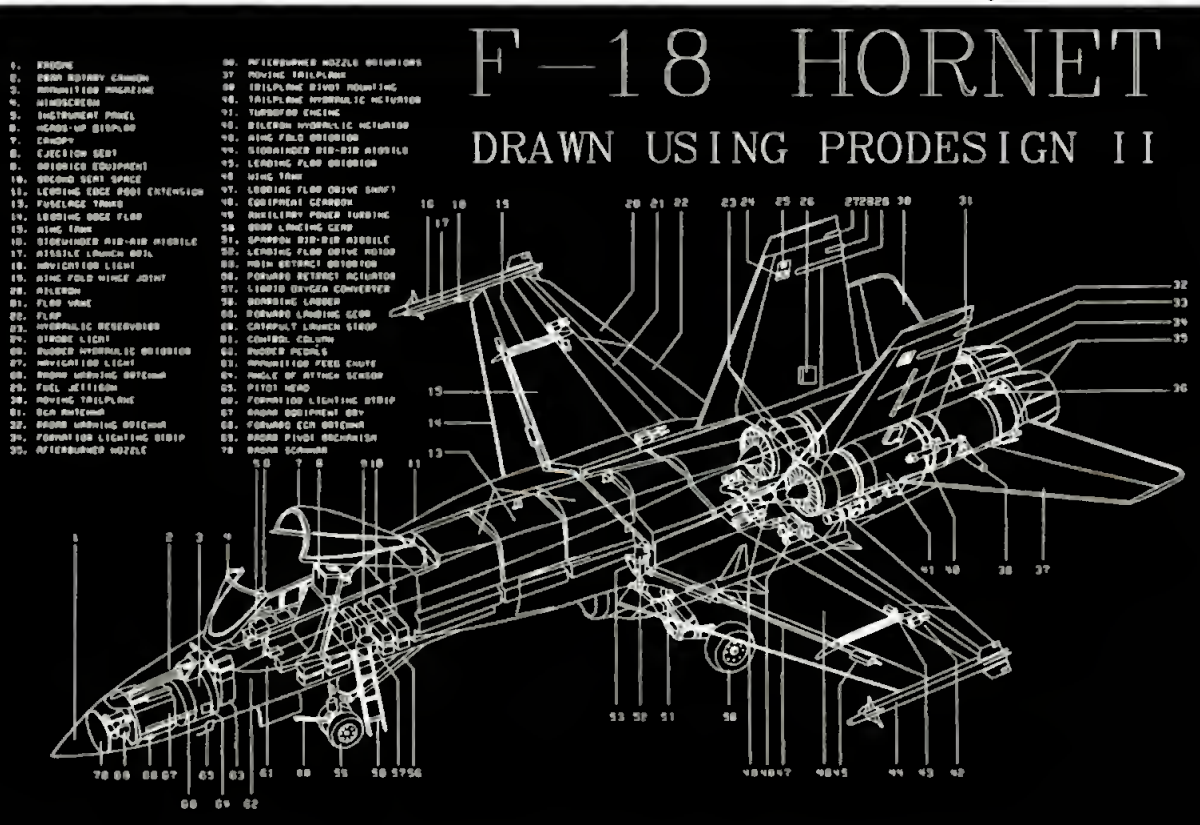


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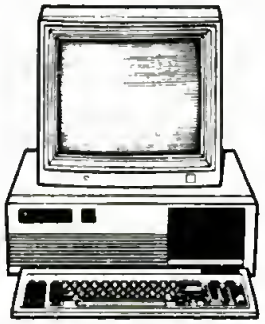

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COVER STORY
FRANK J. DERFLER, JR.

# CONNECTIVITY

# LANs and Beyond

Connectivity is one of the hottest topics of 1986. But while LANs and other schemes for connecting PCs offer many benefits, don't imagine that they provide simple solutions. With this issue, PC Magazine kicks off a series of reports that will give you the hard data you need to cut through the connectivity hype.

So many years have been hailed as "The Year of the LAN" that the label seems more a curse than a description. This year's buzzword is *connectivity*—but this time, technological developments and new products are backing up the buzzword.

What products, for example, are getting the biggest and splashiest displays at large computer shows like Comdex? Invariably, it's a local area network (LAN) or some other system for interconnecting computers.

And look at the sales figures. According to Future Computing,

Photograph: Roberto Brosan

# TALES OF MANY LANs

*Why does a company or a university choose one LAN over another? Five installations detail their decisions.*

Local area networks have emerged from their brawling and turbulent adolescence into the mature world of applications. In pursuit of the perfect network, purchasers weigh a multitude of factors. They decide among a large and often confusing array of software and hardware products and must become versed in both data communications and operating systems theory. Without keen planning, today's perfect network ultimately becomes tomorrow's albatross.

What motivates a user to give up the safety of the single-system PC and explore virtually uncharted LAN territory? Is it the promise of improved productivity, release from the shackles of the MIS mainframes? Is it the lure of shared equipment, shared data, simplification of software distribution, or just plain curiosity that drives the user to seek interconnectivity? Users from all types of installations say it's "some from column A, some from column B."

**A SMALL NETWORK** At the Center for Advanced Professional Education in Santa Ana, California, LAN users share a database as well as programs and hardware, such as modems and printers.

When installing the network, the Center learned that networks often must go through several generations of tweaking and revisions, says Rick Watkins of Micro Development, the consulting firm that installed a small five-node LAN for the Center.

Watkins began with Orchid Technology's PCNET LAN, running a version of *dBASE II* customized to do file locking, and progressed to 3Com's Ethernet. In both cases, as the number of database directories grew, the networks' performance deteriorated. Finally, he settled on Gateway Communications' G/NET, mainly for its good vendor support and low price.

He gives credit for the system's improved performance, however, to software. Watkins chose Novell's *Advanced NetWare* for features that solved some problems he was having with this application. "Using standard software we would need to lock an entire file while we ran a report," says Watkins. *Advanced NetWare*'s file-locking system allows you to read the file even when you can't write to it.

Applications software also offered solutions. Watkins converted the original *dBASE* files to *dBMAN-Net*, a superset of *dBASE III Plus* that uses record locking as opposed to file locking. He then merged the huge collection of small database files into one monolithic file. Because the database management system package can now avoid constantly accessing small files on the server, it achieves five to six times higher performance.

**UNIVERSITY USE** Robert Craig from McGill University believes the best reason to use a LAN is to share data. In the Cardiology Lab at McGill, there is an EKG database and a Catheter database. With the LAN in place, all members of the lab can share these databases.

When Craig was asked to select a LAN for the university, he started with the software. Craig feels that the network operating system supplied by many hardware vendors with their networks is "of questionable utility." So Craig started with Novell's *NetWare*, which is widely recognized for its excellence and which comes in many versions that run on many different networking hardware products.

"Novell's hardware-independent approach allowed me to fully research hardware alternatives and to use a very rigorous set of evaluation criteria for selecting a network," recalls Craig. Today, McGill has six of Standard Microsystems Corp.'s ARCnet LANs and Proteon's ProNET-10 LANs, which each support from 4 to 20 workstations. These LANs are used in administrative, research, and instructional areas of the university.

For the Medical Department of MIT—an ambulatory care center, hospital, and HMO facility for the MIT community—cost and dismal response time were motivating factors for leaving the mainframe environment and looking at LANs. MIT uses its 50-node LAN to allow users to share a large database of insurance records, medical records, patient histories, and other records. In addition, the university saved money by purchasing a LAN because it could buy barebones workstations; the PCs have one floppy disk drive per machine and don't need local hard disks or clocks.

On a recommendation from a consultant, the department chose Proteon's ProNET-10 in conjunction with a Novell server. The ProNET-10 was chosen because it was fast, was token-ring compatible, and was able to run on more types of cabling than other networks. "We felt that token-ring would be the wave of the future even though IBM itself wasn't going that way at the time," recalls Alison Knott, manager of information systems for MIT's Medical Department.

**CORPORATE COMMUNICATIONS** In a large corporation, different departments may have dissimilar reasons for choosing a LAN. Since 1984, Walter Horowitz of Dun & Bradstreet Computing Services in Wilton, Connecticut, has been tracking the growing pains that several business units of D&B Computing Services had with different LANs, including IBM Corp.'s PC Network and Gateway Communication's G/NET.

Horowitz says that the group that chose the PC Network did so because it developed software for PCs and, thinking about the future, wanted to learn about LAN technology. They chose

IBM's LAN because they felt it would gain a great deal of market support. In using the LAN, this group found that as it wrote and stored increasing amounts of code on the LAN and the number of users grew, the server response time for the PC Network degraded. They solved the problem with Novell software, one of the few mature network products available. "Now we use the IBM PC Network hardware but not the software," reports Horowitz, who is delighted with the fact that the software has increased network speed at least fivefold.

Another D&B department, which needed to perform 3278 emulation and to hook into large public networks using the X.25 standard, chose G/NET because Gateway Communications manufactures a number of gateway products that allow the network to interface to other communications systems. "We were somewhat uncomfortable using a nonstandard LAN from a very small company," says Horowitz, "but even if the Gateway network didn't work out, the network interface board was the only unique piece of hardware, so we could easily replace the network."

At Shearson Lehman Brothers in New York, sharing and exchanging ideas and information was an important reason to install a network. The LAN's "chat" feature, which lets users send messages to each other in real-time over the LAN, allows LAN users at the company to brainstorm to their hearts' content. Although saving money wasn't the primary motivation for networking, Shearson Lehman saves money on desktop PCs because the LAN allows PCs to share hard disks and modems.

Another of Shearson Lehman's reasons for networking was control. "We have about 200 PCs installed in our division," says Jude Gartland, a senior vice president of the Investment Bankers Division of the company. "Keeping track of who has what software and who has access to what data gets complicated. We wanted to control the PC environment."

Shearson Lehman's choice of networks, however, was determined in part by matters beyond its control. "We're in a brand new building," explains Gartland. "And the building was already wired with IBM cabling, so the company chose to install Proteon's ProNET-10 because it could use the installed wiring."

**FUTURE PLANS** Planners and implementers of LANs keep one foot firmly planted in today's working system while the other is leaping toward expansion and interconnectivity. "Within the next calendar quarter we'll have all 200 stations in our investment banking division networked," says Gartland. Shearson Lehman is also investigating gateways and bridges to both mainframes and minis.

At Dun & Bradstreet there is talk of expanding to a 1,000-node network, but a large network can create its own set of problems. "When you only have 20 nodes and someone has a problem, you can simply walk around and find it. But if you have 1,000 nodes and some large segment goes down, the task of identifying the cause is magnified and the consequences become more serious," says Horowitz.

MIT is planning to connect its systems using Proteon's network as the main spine. The Medical Department at MIT will "fit right in" to the larger network.

To sum up these plans for networking's future, you can see LAN managers won't have it easy. Give a user a small LAN and the next thing you know . . . you're managing a 200-node network.—**Robin Raskin**

*Robin Raskin is a frequent contributor to* PC Magazine.

■ What products get the biggest and splashiest displays at large computer shows like Comdex? Invariably, LANs and other systems for interconnecting computers.

more than 400,000 local area network interface cards were sold in 1985, and more than a million cards will be sold by the end of 1986. International Data Corp. estimates that in the next 3 years, 10 percent of all PCs will be connected to networks. Other sources project an installed base of 35 million PCs in 1990, which implies a growth rate of a million new networked stations a year.

The primary reason for the spurt in network hardware sales is newly available software. NETBIOS and the DOS 3.1 file- and record-locking standards, introduced in the fall of 1984, have paved the way for networking and applications software programmers to develop software tailored to take advantage of the LAN's file- and record-sharing capabilities. Communications gateways, another development that has spurred the LAN proliferation, let networked PCs talk to a mainframe. Apart from these developments, users are still motivated by the traditional reasons for networking: namely, a convenient way to exchange files and share equipment—such as hard disks and expensive printers—while keeping their computer's local processing power.

Although networking has become easier and more productive, don't imagine that it's a simple solution. Because LAN software and hardware are intimately interwoven with a computer's operating system and interrupt hardware, potential incompatibility and conflicts lurk on many levels. Some networking cards don't get along with certain video boards; some

■ Systems administrators will often resort to unplugging and replugging cards, cables, and connectors network wide to trace a problem to its source.

networking software refuses to coexist with RAM-resident programs; and some processors grind to a halt under network load. Finding what causes such a problem is excruciatingly difficult. Systems administrators will often resort to unplugging and replugging cards, cables, and connectors network wide to trace a problem to its source. Moreover, the entire LAN industry lacks adequate network status reporting capabilities that could help you make the most of your LAN.

**COMMITMENT TO CONNECTIVITY** If you need to connect PCs, you need plenty of solid information. Anticipating your questions, *PC Magazine* has made a commitment to increasing its in-depth coverage of PC networking systems.

With this issue, *PC Magazine* kicks off a series of reports on LANs and other computer interconnection systems. Since networking is so complex, we'll start by introducing some of the basics, such as the components of a LAN and the function and importance of networking software.

Simple circuit-switching systems that let you share files and peripherals as well as powerful, expensive mainframe systems with multiuser capabilities can be alternatives to a local area network. In "An Overview of Networking Options," in this issue, we spell out what these systems are, in what circumstances you might choose one, and how they make their PC connections.

Since May of this year, several technicians from PC Labs have been busily eval-

# GLOSSARY OF NETWORKING TERMS

**Baseband** A network that transmits signals as pulse rather than as variations in a carrier signal.

**Bridge** A connection between two or more similar networks.

**Broadband** A network that carries information riding on carrier waves rather than directly as pulses, providing greater capacity at the cost of higher complexity.

**Broadcast** To send a message to all stations or an entire class of stations connected to the network.

**Bus** A network arrangement in which one channel runs to all nodes on the network and each node must recognize which messages are addressed to it. Similarly, because all stations on a bus use the same channel to transmit, a bus system needs some form of arbitration to determine which station uses the channel when several nodes have messages.

**Carrier sense multiple access with collision avoidance (CSMA/CA)** A method of regulating network transmissions that has each station listen just before transmitting to make sure no other station on the network is transmitting, then send its message. If two stations start transmitting at the same time, the resulting data will be garbled, but the sender will know to retransmit when it fails to get a positive acknowledgment of its message.

**Carrier sense multiple access with collision detection (CSMA/CD)** A method of regulating network transmissions that has each station listen both before transmitting to see if the line is free and also during transmission to see if multiple stations have attempted to transmit at once. If a collision does occur, each station backs off for a small random interval before trying again.

**Carrier signal** A tone or radio signal upon which data rides.

**Channel** A path between sender and receiver that carries one stream of information (a two-way path is a circuit).

**Coax, or coaxial cable** A communications cable made of a center conductor surrounded by a shield or braid.

**Collision** An attempt by two units to send a message at one time on a single channel. In some networks, the detection of a collision causes all senders to stop transmissions, while in others the collision is noticed when the receiving station fails to acknowledge the data.

**Fault** A physical or logical break in a communications link.

**File lock** A software procedure that prevents a second process or user from accessing a file while it is already in use.

**Gateway** A connection between two dissimilar networks. Typically, the gateway is a box or card with cables coming in from both networks. Logically, the gateway takes messages, strips each transmission down to a level in which the systems are the same, and then builds up the message in the form needed by the system receiving them.

**IEEE 802** A set of standards for the physical and electrical connections for local area networks developed by the IEEE (Institute of Electrical and Electronic Engineers).

**Local** Programs, files, peripherals, and computational power accessed directly in the user's own machine rather than through the network.

**Local area network (LAN)** Connected computers in the same building.

**NETBIOS** A set of utilities that send data to and receive data from the network adapter cards.

**Network** A continuing connection between two or more computers that facilitates sharing of files and resources.

**Node** A connection or switching point in a network.

**Open Systems Interconnection (OSI) reference model** A model for networks developed by the International Standards Organization, dividing the network functions into seven connected layers. Each layer builds on the services provided by those under it.

**Protocol** A set of rules for exchanging

information over a computer network.

**Record locking** The exclusion of other users from accessing (or sometimes just from writing to) a record in a file while a first user is accessing that record.

**Redirector** A set of software routines that route requests from user programs to resources provided over the network.

**Ring** A network connection method that routes messages through each station on the network in turn. Most ring networks use a token-passing protocol, which allows the station to put a message on the network when it receives a special bit pattern.

**Server** A station on a network that handles special chores, such as disk storage, printing, or communications.

**Star** A network connection method that brings all links to a central node.

**Tap** A connector that couples to a cable without blocking the passage of signals down the cable.

**Token ring** A type of network that connects stations so messages pass through each station in turn, and that uses a special circulating bit pattern to tell stations when they can put a message on the network.

**Topology** The arrangement of pathways in a network. The most common are rings (where messages pass through each station in turn), stars (where messages pass through a central node), and bus (where each message is presented to all nodes).

**Twisted-pair** The ordinary wire pairs used for some networks and for telephone lines, usually made up of two wires that have been partially wrapped around each other. Twisted-pair is easier to work with than coax cable but cannot support as high a data rate.

**Wide area network** These networks connect computers over areas as wide as the entire world.—**Steve Rosenthal**

---

*Steve Rosenthal is a free-lance writer based in Berkeley, California.*

uating and testing local area network systems. This issue offers in-depth evaluations and benchmark tests of six LANs: Proteon's ProNET-10, Novell's NetWare/S-Net, Standard Microsystems Corp.'s ARCnet, AT&T Information Systems' StarLAN, Gateway Communications' G/NET, and Texas Instruments' Business-Pro LAN Server.

Since all these products were tested running under Novell's networking software, which is one of the most popular packages, you'll find a review of that as well in "Making Connections: LANs Under NetWare." Reviews of other networking systems running networking software from other vendors will appear in subsequent issues of *PC Magazine*, as will updates on other types of connecting products for PCs.

No one can deny that LANs are a complicated subject. If you need more grounding in the details, read on for a brief description of what components make up a LAN and what each is likely to cost. If you're already a LAN system administrator or power user looking for product-specific guidance, skip on to the reviews.

**THE LAN PUZZLE** A local area network for personal computers comprises several key pieces: workstations, servers, networking software, media (usually wire), and network interfaces. The way the pieces hook up physically is called the *topology* of the network. The electrical connection is made through the *protocol*.

You can buy the pieces from different suppliers and put them together yourself, or you can buy a packaged deal from a single vendor. New standards for networking software and alternative sources of hardware make the idea of putting a network together from parts more practical and appealing than ever before.

**WORKSTATIONS** Most people use a personal computer as a workstation. However, some companies market less-expensive workstations designed specifically for networking; these have a processor that's able to run PC software, but they lack the disk drives or communications ports needed for standalone computing.

A LAN workstation runs applications software on its own processor using its own RAM but can store program and data files elsewhere on the network. In contrast, mini and mainframe systems run programs in shared central memory.

**SERVERS** The network file server's primary mission is to store program and data files. But you can also make it function as a print server by attaching one or more printers, or as a communications server by using its serial ports for communicating via modem. Alternatively, you can dedicate separate machines to the print and communications server functions.

The server is usually an IBM PC AT or compatible, but companies such as Novell, Quadram, and 3Com also make machines that are especially designed for the server role. The server must have one or more fast hard disk drives and a processor capable of handling a heavy communications workload. An adequate server can cost as little as $2,500; high-end servers go for over $15,000.

**NETWORKING SOFTWARE** The file server runs a series of programs known collectively as the *networking software*. The networking software's primary functions are moving data between the network and disk drives, controlling data access and file- or record-sharing, and managing security. Networking software can also include such features as electronic mail and network diagnostics.

Networking software packages range in price from $125 (AT&T) to over $1,500 (Novell), but the features offered for the money vary widely. Since the software is such an important consideration, we've covered it more thoroughly in a separate article (see "A Software Key to LANs").

**NETWORK MEDIA** The *media* connects the file server, on which the networking software runs, to the network stations. Usually the media is either twisted-pair wire, coaxial cable, or fiber-optic cable. However, some LANs use such exotic media as infrared light transmission and VHF radio. Some products also allow the use of 110-volt AC power wiring, though with certain limitations.

The media helps determine the LAN's maximum operating speed. Networks designed for IBM PCs or compatibles move

■ The cost of the media and its installation is a major factor in the total cost of a LAN. It can easily run you $1,000 per workstation if you must run coax within walls.

data over their media at rates ranging from 56 kilobits per second to 10 megabits per second. Typical speeds are from 2 to 10 megabits per second. While coaxial-cable systems transmit data faster over longer distances than do twisted-pair systems, fiber-optic systems transmit at speeds up to ten times faster than those using coaxial cable. However, since a LAN's actual operating speed is largely determined by the way the software interacts with the network and the access speed of the server's hard disk, you're usually better off spending money on a better server and software written to maximize the efficiency of the network rather than faster media.

Selecting the proper cabling for your system is something you generally don't have to worry about. Although a wide variety of coaxial cables exists, usually only the cables specified by the network vendor will deliver proper network performance.

Twisted-pair wiring is also specified by the vendor, and it may or may not be simple telephone wire. Fox Research and AST Research market networks that use telephone wire. AT&T's StarLAN can use either telephone wire or special wire that is designed to improve performance. In contrast, when IBM says that its token-ring network uses twisted-pair wiring, it means that the token ring uses a special kind of twisted-pair wiring. This wiring must be a IBM-standard cable designed to connect various IBM terminals and computers. Twisted-pair wiring conforming to the IBM standard costs as much as or more than coaxial cable to install.

Fiber-optic cabling is useful for special installations that have a noisy RF environment or need a long run of cabling and high-speed data transmission. It is not practical for the average installation. The dearth of technicians with the skill to install and maintain this relatively new type of cabling makes the network expensive. Also, the number of workstations that you can attach is limited because each additional station weakens the laser beam traveling through the cable.

The cost of the media and its installation is a major factor in the total cost of a LAN. Cabling can cost literally nothing per workstation if you can use twisted-pair telephone wiring that's already installed, or it can easily cost over $1,000 per workstation if you must run coaxial or fiber-optic cable within walls. Installation charges for coaxial cable typically runs about $4 per foot, plus $40 to add a workstation. In addition, building codes and the type of construction can drive up installation costs.

**NETWORK INTERFACE** The network interface attaches each workstation to the media. Besides serving as a physical connection, the interface controls the signaling scheme—for example, token passing or CSMA—that the network uses to share the media.

The most common network interface found in PC LANs is a circuit board that you insert into the PC's expansion bus. This board usually has a connector for the appropriate media and various integrated circuits that can perform communications and processing tasks. Almost all interface cards have some kind of processor—which can even be a specially designed LSI device—but the processor's power varies widely from network to network. Because DOS is not an efficient multitasking system and because the computer's processor must also do other things, adding processing power on the interface card greatly improves network performance.

Some companies use a separate box to

## OUR EXPERT REVIEW TEAM

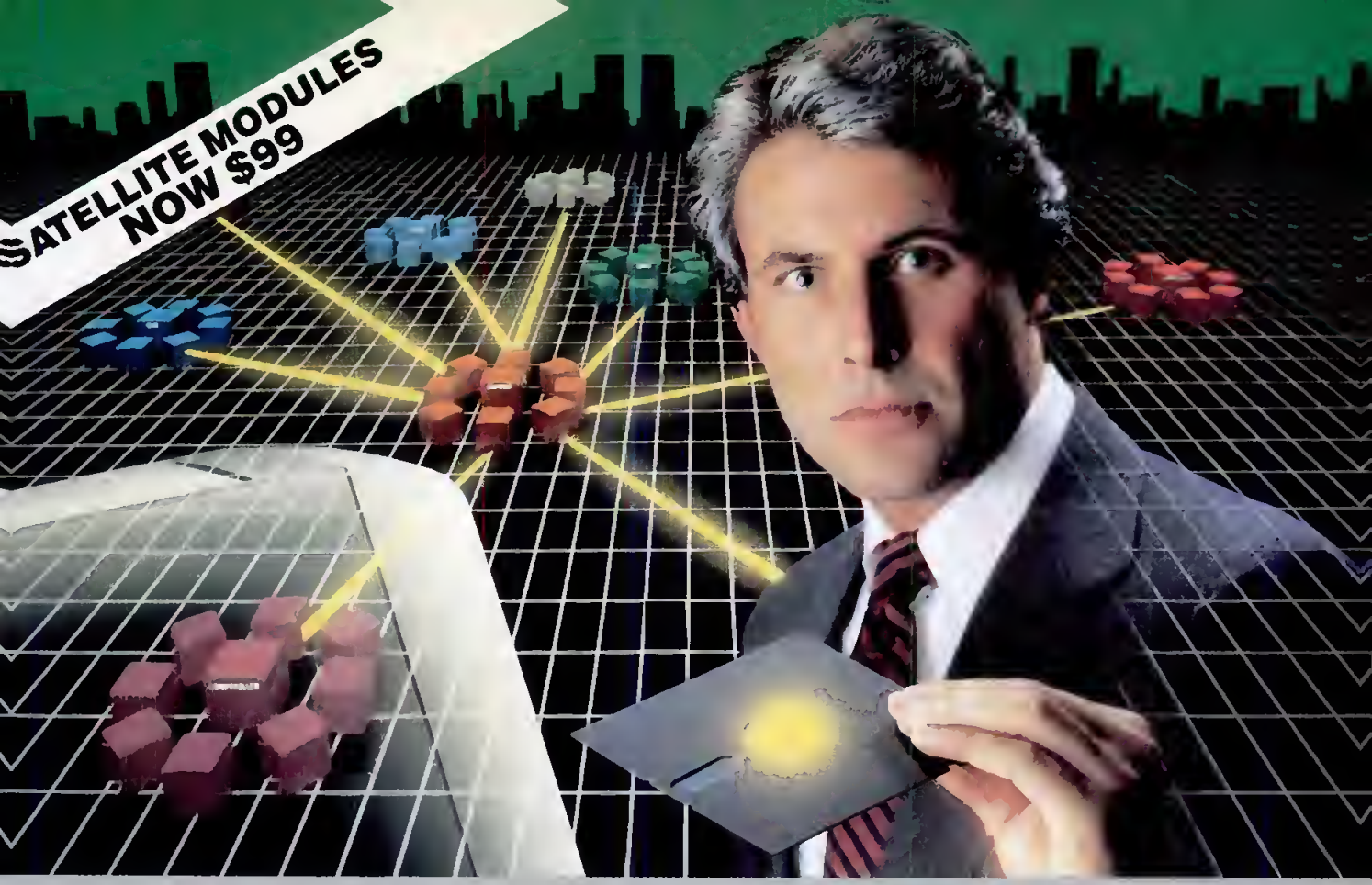
**Frank J. Derfler, Jr.,** is a telecommunications manager for the federal government and a contributing editor of *PC Magazine*. In January he will also begin a regular column for *PC Magazine* on telecommunications. He wrote a microcomputer data communications column that ran for 4 years in *Microcomputing Magazine*. He is the author of four books and hundreds of articles on data communications and microcomputers. In addition, he is a lecturer for New York University's seminar series and a frequent speaker for organizations as diverse as the American Institute of Certified Public Accountants and the Armed Forces Communications Electronics Association.

**Roberto Rivera** is an in-house computer-consultant for George Mason University. He has also worked as a network applications programmer for Chase and Arlington in Rosslyn, Virginia.

**Ed Halbert** is a microcomputer programmer specialist for the Northern Virginia Community College system. He has also been a contributor to *PC Magazine*'s Power User column.

*Foreground, left to right: Ed Halbert and Roberto Rivera; background, Frank J. Derfler, Jr.*

Photograph: Richard Lakin

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interface with the network. These boxes are called network interface units (NIU) or bus interface units (BIU). Workstations connect to the NIU through an RS-232C cable. The advantage of NIUs or BIUs is that they allow you to connect almost any RS-232C device to the network. (What the unit does with the connection is determined by the network operating system, screen display, and other factors.) The primary disadvantage of a standalone NIU or BIU is cost. Since they include a cabinet and power supply, these boxes cost more than a simple interface card. Prices for interface units range from just below $500 to slightly over $1,000 each.

Zero-slot (or RS-232C) LANs use the RS-232C port on the PC for all connections. Since zero-slot LANs are available for less than $100 per workstation, using RS-232C cable as the only media can save a large amount of money, but it foists the processing workload usually borne by the network interface cards onto the processors in the individual workstations. You pay for this added workload with reduced speed and capability.

**TOPOLOGY** The topology of the LAN refers to the way all the pieces hook together. There are three basic types of topologies: ring, bus, and star. Generally, in a *bus topology*, a single cable runs past all the network workstations. All the stations are either connected directly to one another or to the trunk line through a short drop cable. In a *ring topology*, workstations are linked together the same way as in a bus, except that the two ends of the cable are hooked together. In a *star topology*, individual cables run from either the server or a wiring hub to each workstation.

The topology affects the cost and ease of maintaining and troubleshooting the system. A bus requires less wiring than a star, for example, so it costs less. But a star is easier to troubleshoot: you can simply unplug each station in succession to find the one causing a problem rather than dismantle major portions of the system.

**PROTOCOL** PC LANs share writing and regulate their transmissions through connection schemes called protocols. A protocol is one of the least important factors to consider in purchasing a LAN,

■ Besides serving as a physical connection, the interface controls the signaling scheme.

since it is virtually invisible to the user. However, you'll probably see different protocols mentioned frequently in books and articles about networking, so you'll want to know what they are.

Polling, CSMA (carrier sense multiple access), and token-passing are all media-sharing protocols, although token-passing and CSMA are the most commonly used. In a polled system, a controlling station addresses a message to each workstation asking that station if it has any messages or data to transmit.

In contrast, the CSMA protocol operates on a listen-before-talking principle. Not unlike citizen-band or police radios, CSMA protocols transmit only if the channel seems clear. However, since two stations could begin transmitting at the exact same instant, their messages could collide. Hence various monitoring and collision-avoidance circuits are used to detect these collisions. The letters "CD" added to CSMA indicate the presence of these special collision-detection features. Ethernet is the most commonly used CSMA/CD system, but many other networks also have CSMA/CD.

The protocol in token-passing networks calls for the exchange of a message, or *token*, that gives a station permission to transmit. As stations pass the token, complex rules prevent users from hogging the transmission system. The IBM Token Ring Network and Standard Microsystems' ARCnet are both token-passing systems, but operate very differently.

Our coverage of local area networks is meant to identify all the alternatives and give you the facts you need to evaluate them knowledgeably. The background provided here should help you examine the individual systems described in "Making Connections: LANs Under NetWare." PC

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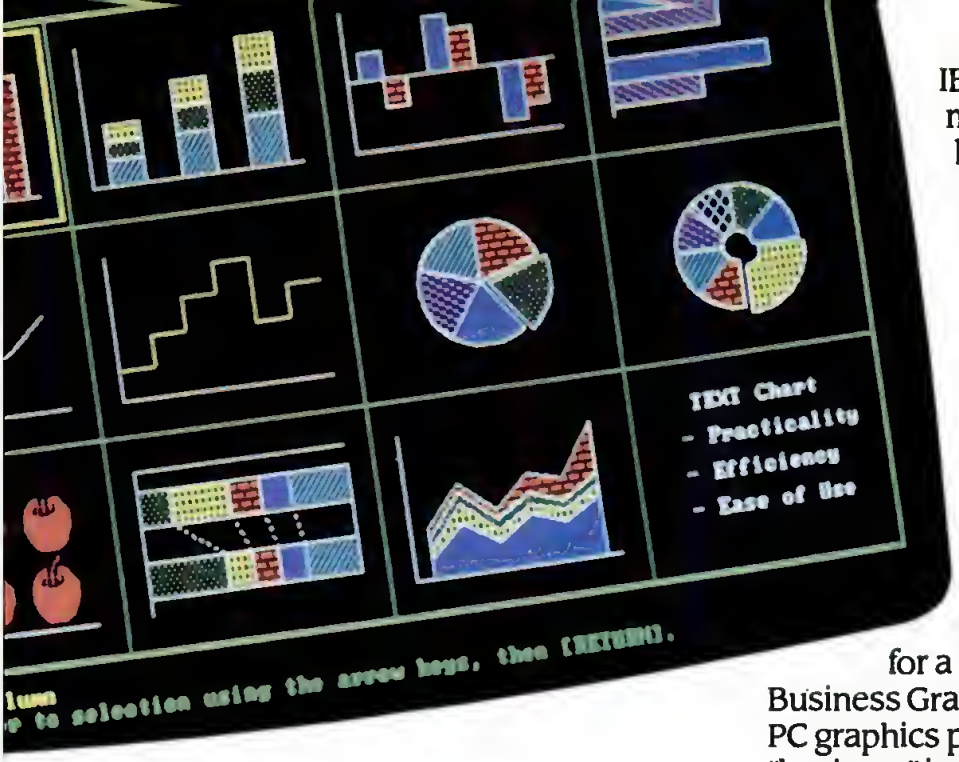


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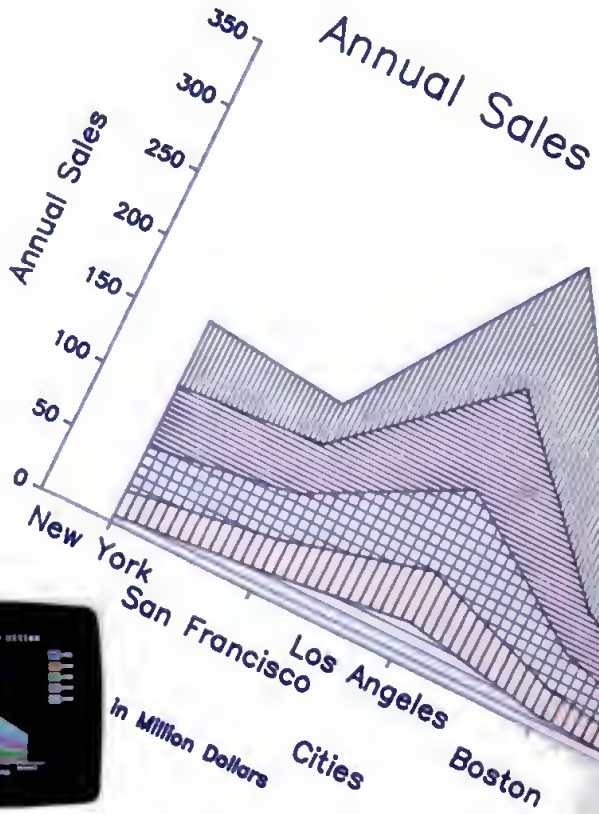


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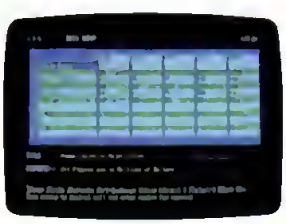

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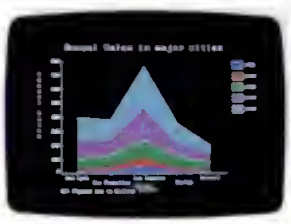

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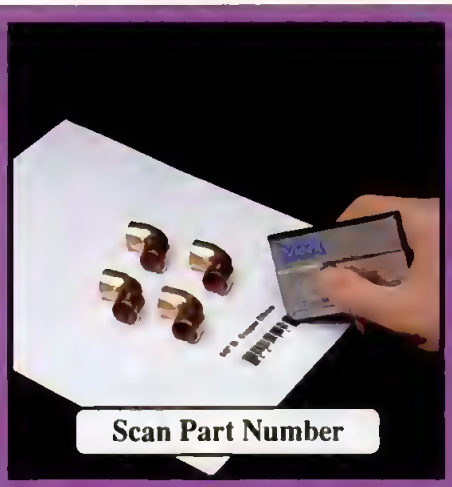

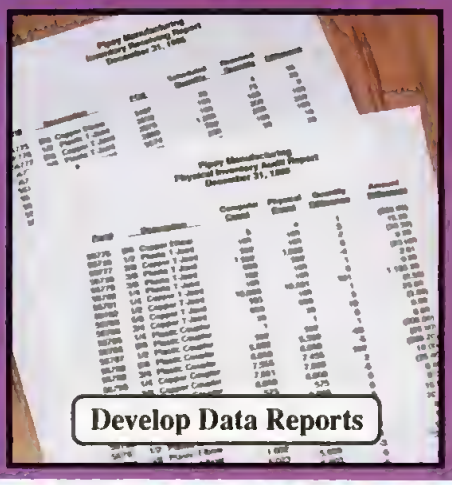


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# The Software Key to LANs

With all the hardware that goes into a LAN, who would think that software determines most of your network's features? To make an intelligent LAN decision, it's vital that you understand what the networking software does and how it operates.

COVER STORY
FRANK J. DERFLER, JR.

Many of the networking features you have to consider when making a LAN purchasing decision will be features of the networking software. Since many networking systems can work with more than one networking software package, you'll need to make a choice. And to make an intelligent one, you must understand what the software does, the way the software is sold, how all the pieces of the software work together in layers, as well as how and why different vendors vary the basic scheme.

Networking software is really a series of programs that reside on the server. Their primary function is to move data between the network and the server's disk drives, to control the sharing of files and records, and to control access to data. In addition, networking software can include such options as electronic mail, security programs, and network diagnostics.

Novell and Microsoft Corp. are the leading vendors of networking software. The current version of Novell's product is called *Advanced NetWare* (see "Making Connections: LANs Under NetWare" for our review). *NetWare* comes adapted to and bundled with many other vendors' networking hardware. *NetWare* also comes in three generic versions: *Advanced NetWare/86* for servers running the 8086/88 processor, *Advanced NetWare/286* for servers having the 80286 processor, and *SFT NetWare (System Fault Tolerant NetWare)*, which allows the system to continue functioning should one or more system components fail.

Microsoft does not market *Microsoft Networks* to the public as a retail product. Rather, the company licenses *Microsoft Networks* as a series of modules to major companies that, in turn, combine, enhance, and sell them with their own hardware. These modules include sections called the server, redirector, print spooler, some utilities, and NETBIOS. Notable among the *Microsoft Networks* licensees are IBM Corp., AT&T, Ungermann-Bass, and 3Com. Other companies, including Novell and Fox Research, have written their own networking software that they claim is compatible with *Microsoft Networks*.

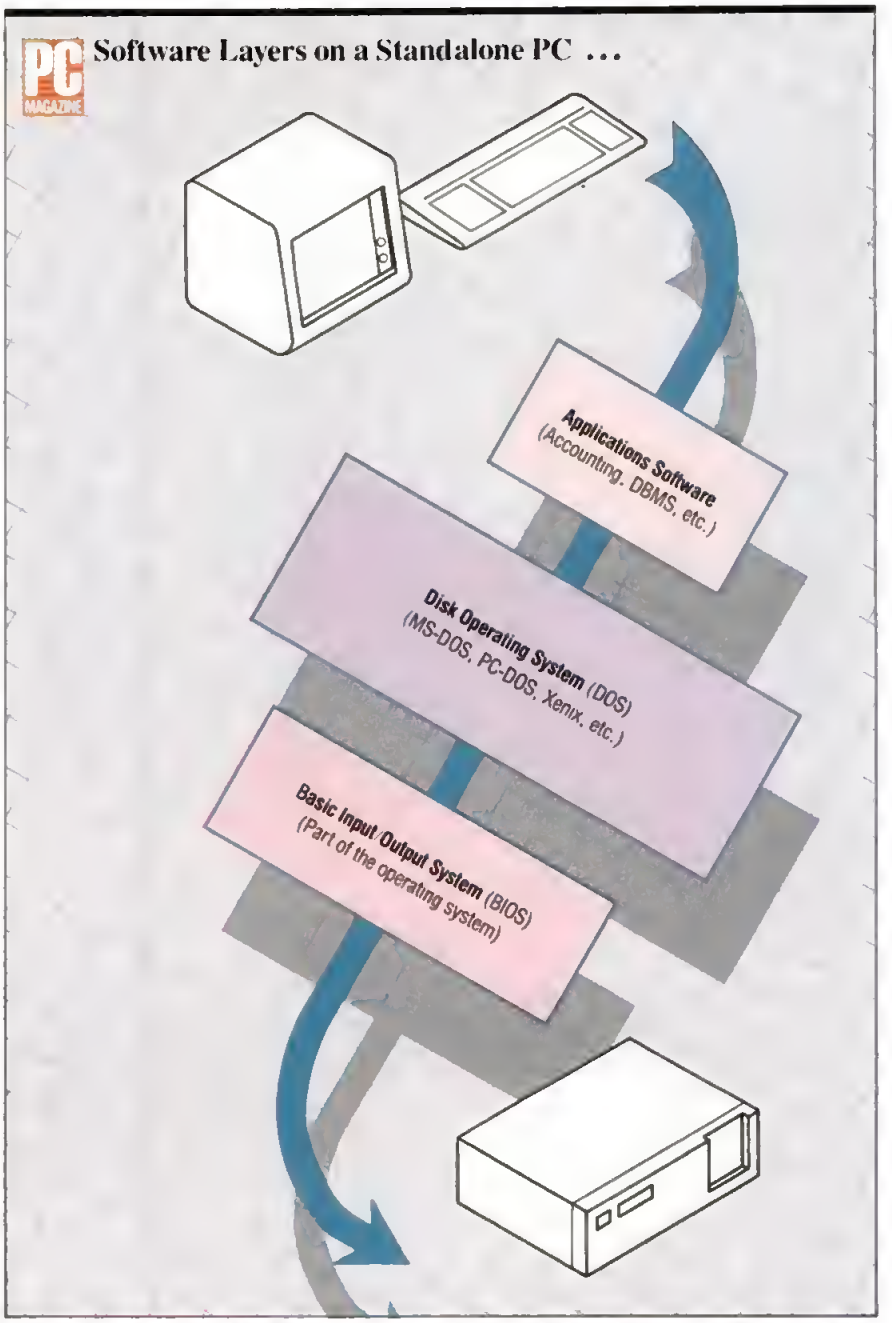
**SOFTWARE LAYERS** To understand how networking software works, it's useful to compare it with software on a standalone PC (see "Software Layers on a Standalone PC vs. a Network Server"). A standalone PC requires several layers of programs and subroutines that must work together. The bottom layer consists of a machine language program, called the basic input/output system (BIOS), that manages all serial peripherals. In the IBM PC, this BIOS is partially in ROM and partially in the hidden system file called IBMBIOS.COM. IBM PC compatibles usually read all of the BIOS from disk at startup.

The layer above the BIOS consists of the disk operating system (DOS) software. All versions of MS-DOS and PC-DOS through Version 3.0 were designed for single-user applications, meaning that their BIOS and DOS layers are capable of performing only one task at a time.

The third and final software layer for a standalone PC is the applications software, which interacts with the DOS and BIOS in order to receive data from a disk, keyboard, or port or to transmit data to a video device or port.

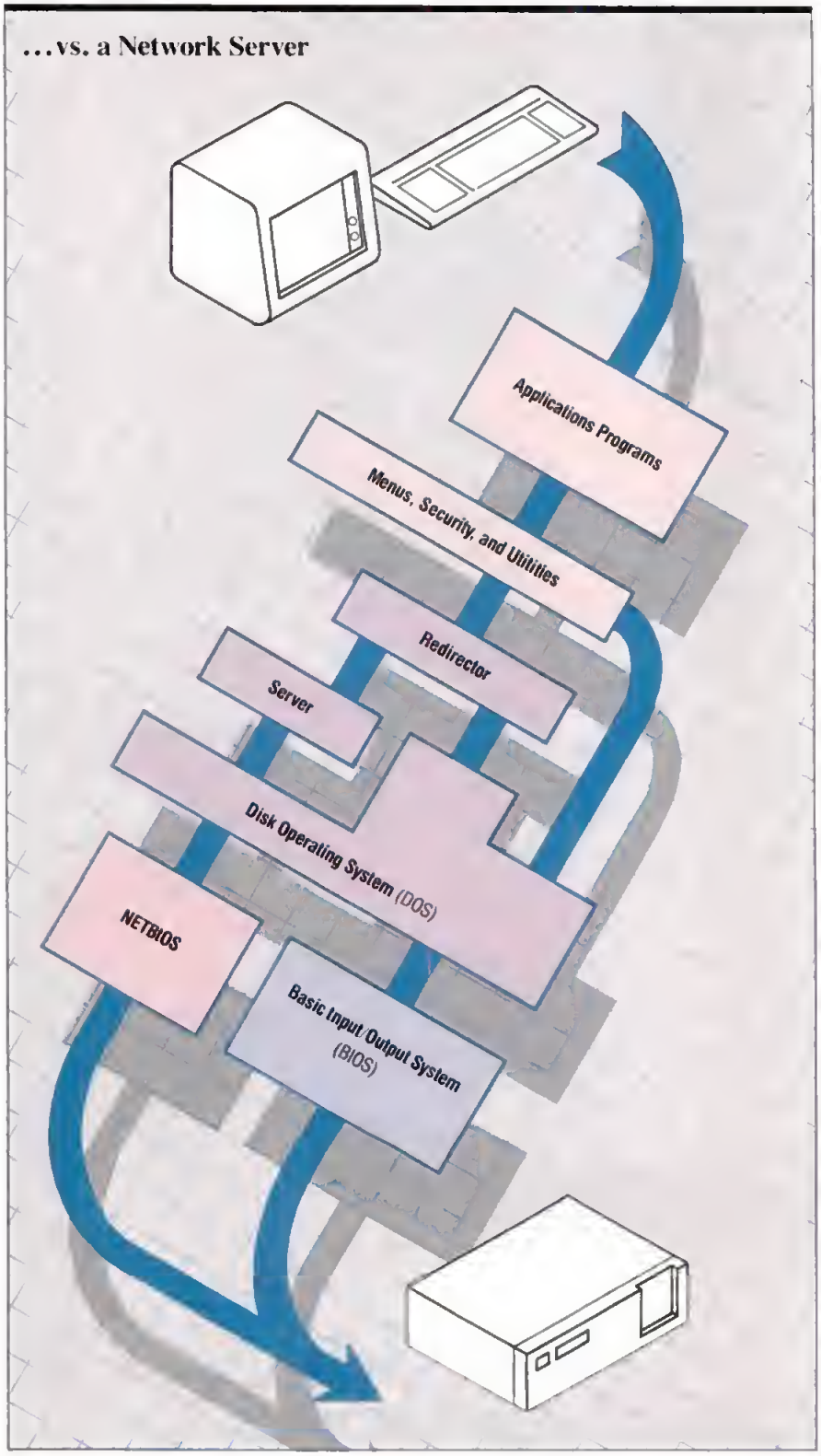
**NETWORK SERVER LAYERS** Network workstations use the basic software layering described above. Networking software runs only on the server and adds a number of utilities and layers to the basic software layering scheme (see network server diagram).

Two pieces in the layering scheme have been instrumental in kicking off the recent




▲**Software Layers on a Standalone PC** A standalone PC requires three layers of software that must all work together. The lowest layer is a machine language program called the BIOS that manages serial peripherals. The operating system, DOS, forms the second layer. And applications software, the final layer, interacts with the hardware through DOS and the BIOS to transmit data to and receive it from a disk, keyboard, or port.

▶ **Layers on a Network Server** Networking software for a network server adds layers and modules to those required to run standalone software. NETBIOS fits into the layering scheme at the BIOS level. It sends data to and receives it from the network adapter card. The second layer is DOS 3.1. At that layer are programs called the server and the redirector. The server layer allows every workstation on the network to share its disks and peripheral devices with the network and to exchange data with other workstations. The redirector layer determines when data should go out to and be received by the network. On top of the redirector sits the remainder of the networking software package. This layer may contain security routines and menus. Applications packages sit on the very top.




proliferation of applications and networking software: DOS 3.1 and NETBIOS. DOS 3.1, from Microsoft and IBM, added to the normal DOS functions file- and record-locking capabilities, as well as calls and signals (called semaphores) that work through the networking software to regulate applications programs' access to files. Without file and record locking, simultaneous multiuser access is impossible because the last person to save data to a file overwrites the data inputted previously. In addition, NETBIOS, developed by Sytek and IBM, allows the networking cards to talk to your PC's hardware. DOS 3.1 and NETBIOS have become standards. Both applications programmers and networking software vendors, Fox Research and Novell included, have scurried to include these standards in their networking software for the benefits of file and record locking.

The advent of these standards, announced in the fall of 1984, marked a turning point in networking and applications software development. Prior to DOS 3.1, applications programmers faced dealing with different file- and record-locking schemes from different vendors. Novell, for example, produced a widely accepted networking software package that included its own file- and record-locking procedures, but other successful companies, such as Fox Research and 3Com, marketed their own software, which worked quite differently. Some vendors ignored the issue altogether and limited their networks to file-swapping and printer-sharing jobs. Now networking and applications programmers can write to a standard.

**NETBIOS** NETBIOS fits into the software layering scheme at the lowest level, the BIOS layer. The NETBIOS sends data to and receives data from the network adapter card, just as the regular DOS BIOS communicates with the serial, parallel, and other communications ports.

Companies have the choice to either license Microsoft's NETBIOS module or develop their own compatible BIOS software. Sytek, which helped develop NETBIOS, includes the utility on its network interface boards. Other network companies usually include a version of NETBIOS, customized for their hard-

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**Third, you have full compatibility.** All existing system RAM, hardware, and peripheral cards can be used without software modification. It operates with LAN and mainframe communication products and conforms to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). Software compatibility is virtually universal.

**Fourth, it is the best there is.** There are several other boards on the market. Some are priced about the same as the *BREAKTHRU 286* and some are cheaper. We at PCSG have compared them all, but there simply was no comparison. What we discovered is that many cards being sold offer only a marginal speed up in spite of their claims. We found some to be merely versions of the obsolete 8088 or 8086, and others to be just poorly engineered. The 8MHz *BREAKTHRU 286* is unequivocally the best executed and most completely reliable speedup board manufactured today.

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## Some Applications Software Suggestions for Your LAN

The growing availability of applications software that meets the NETBIOS and DOS 3.1 standards has helped fuel the growth of local area networks. And currently the most numerous networked applications are DBMS, accounting, and word processing packages.

Of these applications, multiuser database and accounting applications give you the most productivity punch for your networking dollar. Using such packages on a LAN, many business users can input, retrieve, and distribute information at the same time from the same file. Every business needs some sort of accounting packages. In addition to using the file- and record-locking capabilities of a multiuser database, networked accounting packages allow you to specify various levels of security for sensitive financial data.

Networked word processors allow users to create and edit their work on their own computers, store it on a shared hard disk, and print it on shared printers. In addition, you can send your manuscript over the network to a co-worker, rather than run down the hall with a disk.

Other, less-common networked applications include integrated software, communications packages that let users "chat" with others on the network in real-time or leave messages in an electronic mailbox. Another area of growth is in the CAD field. Often, design projects are undertaken by teams of engineers and designers. Networked CAD packages act as massive databases that let you store libraries of images, call them up, and manipulate them at will. Hence, various users can input, store, recall and modify basic designs.

If you have a LAN or are thinking of checking one out, here are some packages that will get you started:

**DBMS** *dBASE III PLUS* (Ashton-Tate, Torrance, California), *R:base 5000 System V* (Microrim, Bellevue, Washington), *Revelation* (Cosmos Inc., Seattle, Washington), *DataFlex* (Data Access Corp., Miami, Florida), and *Informix-SQL* (Relational Database Systems Inc., Menlo Park, California).

**WORD PROCESSING** *WordPerfect* (Satellite Software International, Orem, Utah), *MultiMate Advantage* and *MultiMate Professional* (Ashton-Tate, Torrance, California), *Samna Word III* and *Samna* + (Samna Corp., Atlanta, Georgia), *OfficeWriter* (Office Solutions Inc., Madison, Wisconsin), *WordStar 2000* (MicroPro International Corp., San Rafael, California), and *Microsoft Word* (Microsoft Corp., Bellevue, Washington).

**ACCOUNTING** *EasyBusiness* (Computer Associates, San Jose, California), *Solomon* (TLB Inc., Malvern, Pennsylvania), the *Medallion* collection (Timberline Systems Inc., Portland, Oregon), and selected accounting packages from Open Systems Inc., Eden Prairie, Minnesota; Real World Corp., Chichester, New Hampshire; and CYMA/McGraw-Hill, Mesa, Arizona.

In addition, since many accounting programs are written in COBOL, BASIC, or other languages, you can add appropriate commands to control record locking with programs such as RM/COBOL (Ryan-McFarland Corp., Rolling Hills Estates, California).

**—Cheryl Goldberg**

ware, with the networking software.

Each networking company includes unique features on its adapter cards that must integrate with the NETBIOS functions. If you want to use NETBIOS with another vendor's cards, you must have the right version or an emulation of the right version for the network adapter card you intend to use.

In the early days of the IBM PC, some applications made direct calls to the PC's ROM BIOS in order to speed screen displays or perform other functions. Developers soon found that such programs could not run on many PC compatibles. Similarly, some networking applications developers are using NETBIOS calls in applications, such as electronic mail, that can benefit from peer-to-peer communications. Other network communications tasks, ranging from finding the status of other stations to checking copy protection, can be done quickly through NETBIOS. Because you may someday run programs on your network that use NETBIOS, be sure the networking software you choose either uses Microsoft's NETBIOS or is truly compatible.

■ The NETBIOS sends data to and receives data from the networker adapter card, just as the BIOS communicates with serial and parallel ports.

**THE SERVER AND REDIRECTOR** In the network-layering scheme, DOS is still the layer above the BIOS. But networking software adds modules that sit next to and on top of DOS. Some versions of the *Microsoft Networks* software add a program on top of DOS, called the server, that allows every workstation to share its disks and peripheral devices with the network and to exchange data in what is called peer-to-peer communcations. In effect, this makes every workstation on this network a server.

Above and next to the server is the redirector layer. The redirector layer acts

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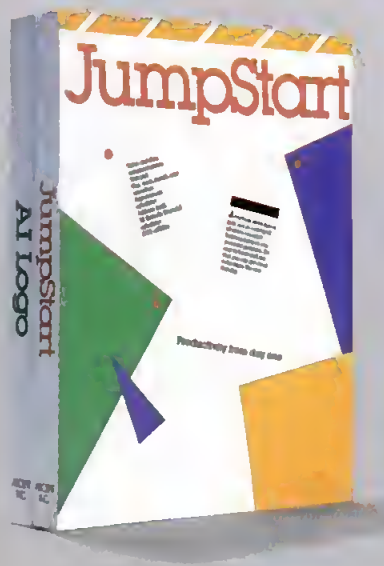


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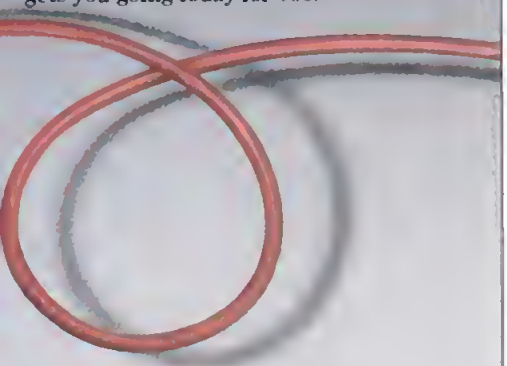

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■ Applications programs with sole access to data files need no special features to run on a LAN.

as a traffic controller within the networked PC, determining when data should go out to or be received from the network.

The remainder of the networking software package sits on top of the redirector. This layer may contain security routines to identify network users and menus to help network functions.

**APPLICATIONS PROGRAMS** Applications programs with sole access to data files—on either the local disk drives or the disk drives on the server—need no special features to run on a network. Perennial favorites like *WordStar* and *1-2-3* work fine on a network as long as each person using them accesses only his own files. (There are also licensing limitations on multiple stations running the same copy of the program.) But if two people try to access the same spreadsheet file with *1-2-3*, one of them can lose all of his work. The last person writing the data file back to the disk erases everything anyone else saved.

If programs on a network share the same records or files, they must be designed to read the signals presented by DOS 3.1 and take appropriate actions. For example, a DBMS (database management system) program that allows several operators to access and update a warehouse inventory must contain lines of code directing DOS to lock a record or file while it is in use. The creator of the DBMS application also has to put in routines responding to the "locked" signal from DOS and informing the operator that the record or file is in use and cannot be modified.

Although the scheme described can be used as a basic sketch of networking software layers, different vendors make some modifications to this scheme. For example, while Novell layers its software in a manner similar to that used by DOS systems, it supplies its own operating system for the server. This operating system uses disk caching to hold portions of the data in memory for easy access and uses a technique called elevator seeking to put requests for data into an order that makes efficient use of the hard disk. Novell's server operating system significantly increases the speed of disk read and write actions through the network.

Novell's *NetWare* requires a computer on the network be configured as a server if it is going to share resources. But the software will allow you to partition the server's hard disk so that you can also use the server as a workstation operating under DOS—although using the server in this way slows the performance of both the workstation and the server. The portion of the server's memory formatted for the Novell operating system is not directly available through the server's keyboard because of technical differences between the Novell operating system and MS-DOS. But it serves as a good security device since all files must be accessed through the network, with its security system.

Novell calls the software performing the function of the redirector the DOS shell. But while the technical details of how Novell's shell and Microsoft's redirector operate are different, what they do is similar.

Banyan and AT&T use UNIX as the operating system for their servers. UNIX is designed for multiuser operation. The AT&T systems can service directly attached terminals running UNIX applications while servicing a network of PC/MS-DOS workstations.

**ADDED FEATURES** Even if two companies should both license *NetWare* from Novell or *Microsoft Networks* from Microsoft, their final networking software may look very different to the people using the network. Each network vendor can add menus, icons, or utility programs to make its software easier to use or more useful. You'll find the full list of software features and how they work in this issue in "Making Connections: LANs Under NetWare" and in "LANs Under NetWare: Summary of Features." And, of course, the reviews will tell you which network has which of these features.

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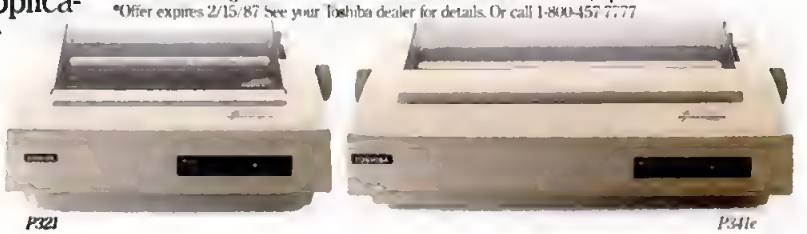


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# An Overview of Networking Options

Basically connectivity is about sharing data and sharing expensive equipment. But LANs are only one of the many ways to pool resources. Your alternatives range from circuit-switched systems to LANs to minis to mainframes. You may decide to stick with a LAN, or you may choose one of the many options detailed here.

COVER STORY

FRANK J. DERFLER, JR.

When you get right down to it, connectivity is all about two things. Personal computer users with common interests want to swap files and access common databases. And organizations want to cut costs by sharing expensive equipment such as hard disks, laser printers, and vertical plotters.

The cover story in this issue of *PC Magazine* is primarily about local area networks. But LANs are only one of the many possible ways to share resources. In fact, there are so many ways to share data and equipment that you may choose from a continuum of alternatives with many gradations, from the simplest to the most complex. You may decide to use a LAN or you may determine that one of these other connection schemes will more closely fit your needs.

One way to distinguish between these many alternatives is to consider the connection scheme they use to hook workstations and/or computers together. A connection scheme refers not to the type of media used—you can use any type of media, from telephone wires to fiber-optic cable—but rather to the way these users share the media.

Connection schemes range from temporary circuit-switched connections, like those made during a telephone call, to permanent connections made between mainframe computers and their terminals (see diagram, "Networking Alternatives"). PC LANs use a mix of permanent and temporary connections: LAN workstations are permanent-

ly linked together by wires but the connections are "temporary" since they exist only as the stations take transmitting data through those wires. Media-sharing protocols—CSMA, polling, and token passing, described in "Connectivity: LANs and Beyond" in this issue—make sure that each workstation has access to the network and that data is not lost through collisions.

Economy and performance are important factors in selecting an information-transfer alternative, and we cover those, too. But the type of connection scheme affords a clear-cut way to differentiate between these systems.

**CIRCUIT-SWITCHED SYSTEMS** Circuit switching is the simplest sharing alternative, and the most familiar. You use it every time you make a telephone call. Circuit-switched connections are temporary, lasting only for the duration of the call or session. A switching device makes the connection. Like two people chatting on the phone, two systems communicating through a circuit switch talk only to each other; they cannot send data to or receive it from any other stations. The only form of traffic control is a busy signal.

If you want to exchange files and share printers, a circuit-switched system running the proper software could be all you need. These communications networks are relatively inexpensive and—most important—require little support from network programmers or administrators.

Circuit-switched systems include "sneaker net," RS-232C patch boxes, data PBX, digital PBX, and Centrex systems. For a simple connection scheme, consider the techniques described below.

**SNEAKER NET** Often it's the same people who, at home, informally exchange programs or data files that want an expensive local area network to perform the same function at the office. But if you simply need to exchange and update data files once a day or once a week, *sneaker net*—simply trading disks—is cheaper and more reliable than any electrical data-exchange scheme.

If you need a jargony way to justify your choice of sneaker net, you could say that exchanging disks is a circuit-switching connection scheme with a short connection time and very high bandwidth. Using sneaker net, you can make a connection in the instant it takes to hand over a disk. A disk can transfer 360K bytes or even 1.2 megabytes of data to a PC down the hall in seconds. Express package delivery services can move disks with gigabits of data across the nation overnight without garbling a single bit. And exchanging removable high-capacity storage media like tape and Bernoulli Box cartridges results in an even wider bandwidth transmission.

■ Using sneaker net, you can make a connection in the instant it takes to hand over a disk.

Other methods of moving data may have more pizzazz, but why pay for the sizzle on a steak when a hamburger will do just as well?

**RS-232C PATCH BOX** For making one or two connections a day outside your standalone PC system, you might consider an RS-232C patch box connection scheme. This scheme is also good for sharing serial devices like laser printers. Moreover, while the maximum speed of data in a patch box network depends on the quality of the cable, the distance, and other factors such as electrical noise, this simple network can make error-free transfers at 9,600 bits per second.

The *RS-232C patch box* is a circuit-switching device that has probably been reinvented more times than any other device in the history of tinkering—electronic or otherwise. People using PCs for many different applications have found it economical to run RS-232C cables from each computer to a central patch box. Each cable terminates in an exposed connector, and you use short jumper cables at the patch box to link any two connectors—just like an old-fashioned switchboard. However, one drawback of the RS-232C patch box is that you'll have to move relatively thick RS-232C cable if you transfer a workstation to an unwired location.

To transmit and capture the files exchanged through the patch box, you use a communications program such as *Crosstalk*. *Crosstalk* can transfer data between two computers at over 32,000 bps in some RS-232C patch box installations.

Commercial versions of the patch box are available from Black Box Corp. in Pittsburgh, Pennsylvania, and Devoke Co. in Santa Clara, California. Devoke prices a 48-port patch box able to switch six wires (adequate for most RS-232C jobs) at $261.

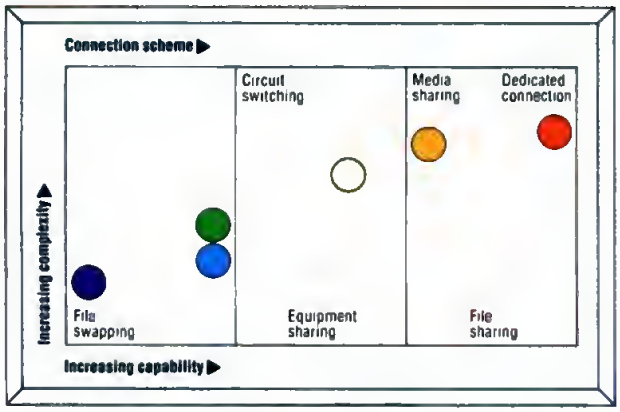
**DATA PBX** If workstations in your office typically initiate as many as a dozen connections a day to large host computers, other workstations, or peripherals such as printers and plotters, you might want to consider a data PBX system. The data PBX automates the RS-232C patch box for relatively high-speed (a maximum of 9,600 bps) circuit switching. Data PBX devices are generally less expensive and less complex than PC LANs.

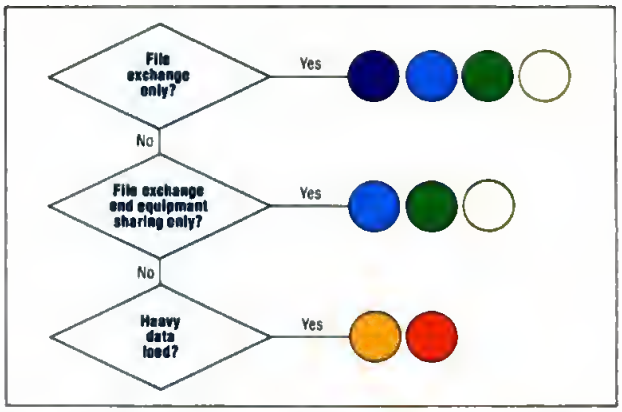
Like a patch box, a data PBX usually gives you just the communications path. You must use communications software in the connected PCs to send and receive files or to use a printer. All attached devices must run at the same speed, use the same data alphabet (usually ASCII), and exchange the same control codes. Neither data PBXs nor patch boxes normally do any speed conversion or translation of screen graphics characters (there are exceptions).

The acronym *PBX* stands for private branch exchange, and most people think of a PBX as a voice telephone device. A *data PBX* is a special kind of switch that makes connections between computers and terminals attached to its ports by remote command and then disconnects when the session is completed. Computers and terminals might connect to the data PBX through multiconductor cables using the RS-232C signaling scheme or through various kinds of two-wire or four-wire connections using the RS-232C port and cable adapters.

A data PBX can be a very friendly device. Typically, you get its attention by sending it a couple of carriage returns or a break signal. Some systems return a special prompt and wait for a connection com-

## Networking Alternatives




Once you've decided to connect your PCs, you'll quickly discover that you have many categories of products to choose from. One way to distinguish between these categories is to consider the connection scheme they use to hook computers together. Above, *PC Magazine* diagrams these alternative connection schemes. As you scan the illustration from lower left to upper right, you'll notice that the alternatives offer increasing capability and complexity. Your simplest choice is to swap disks. Slightly more complex are circuit-switching systems that let you share files and peripherals. LANs occupy the middle ground of capability and complexity, allowing the most sophisticated form of data sharing: simultaneous multiuser access to files. Finally, at the upper right are mini and mainframe computer systems, which also offer file sharing. In the captions and decision matrix, upper right, you'll find a quick synopsis of each system's capabilities and sharing scheme.

**Disk exchange** If you simply need to exchange and update data files on a daily or weekly basis, simply trading disks (popularly known as "sneaker net") is cheaper and more reliable than any electrical data exchange scheme.

**RS-232C patch box** For making one or two connections daily with other computers or to share peripherals, an RS-232C patch box is an inexpensive alternative. To use this circuit-switching device, you run RS-232C cables from each PC to a central patch box. When you need to make a connection, you link any two cables using jumper cables. You then use a communications program to send and receive files.

**Data PBX** To make up to a dozen connections a day to other computers or to share peripherals, you might consider a data PBX. This scheme automates the RS-232C patch box for inexpensive, relatively high speed circuit switching. One drawback is that neither data PBXs nor RS-232C patch boxes do any speed conversion or translation of graphics characters. In addition, all attached devices must use the same data alphabet.

**Digital PBX and Centrex** These two circuit-switching schemes look different but function identically, allowing you to send voice and data over telephone lines. Both systems let you make dozens of connections daily and move workstations easily. In addition, these systems allow you to connect devices that use different transmission speeds, and they can convert some control codes. A digital PBX is a modern voice-and-data telephone switch, controlled by a computer. Centrex is a service offered by your local telephone company.

**Local area networks** While more expensive than circuit-switching systems, LANs offer a more sophisticated form of data sharing: they allow many users to access the same files simultaneously. You can also use a LAN to share files and peripherals. Workstations in a LAN are connected permanently with wires, but they take turns using those wires. Access protocols, such as polling, CSMA, and token-passing, control the sharing of wires.

**Mainframes and minis** If you need to establish several simultaneous sessions for database inquiries, electronic mail, or other jobs, or if you need long, dedicated file transfers or fast, highly interactive operations, choose a mini or mainframe. These systems also allow you to store huge amounts of data. Minis and mainframes use permanent, hardwired connection schemes.

mand. Others furnish a list of the attached systems for you to choose from. You tell the switch what workstation or computer you want to connect to and, if that port isn't busy, the data PBX hooks you up. Some systems will form a queue for a busy port.

The data PBX system is not a new phenomenon. Thousands have been installed, and major companies like Micom Systems, Gandalf Data, and Davox Corp. are the leaders in this business. Versions of these switches are available for as few as 8 and as many as 4,000 lines, and they can do a dandy job of establishing connections between PCs. In the bigger systems, costs can be as low as $100 per port and usually don't run over $250 per port.

**DIGITAL PBX AND CENTREX** Centrex and digital PBX connection systems allow you to move workstations easily and complete dozens of connections efficiently. Unlike data PBX systems, both modem Centrex and digital PBX systems connect devices that use different transmission speeds and can also convert some screen and printer control codes. Some of these systems can move data over twisted-pair wiring at speeds ranging up to 56 kilobits per second, although 9,600 bps is more common.

Although a digital PBX and a Centrex system look different, their functions are identical. *Digital PBX* is the term used to refer to a modem voice-and-data telephone switch. The heart of a digital PBX is a computer that you keep in your building. This computer can be anything from a PC using the 8088 processor to AT&T's 3B20 computer system with a 32-bit chip.

It's easy to put an RS-232C connector on the back of a digital telephone for voice-plus-data service. This is how digital voice transmission works: A processor in a telephone attached to a digital PBX digitizes the speaker's voice at the point where the curly cord comes out from the handset. The digitized voice travels through the system until another phone attached to the PBX converts it back to analog or until the PBX switch converts it back to analog and sends it on to outside phone lines.

A digital telephone can also transmit data. You connect your PC to the digital phone using an RS-232C connector. The phone will transmit data directly to another digital phone attached to the PBX system. If you call a number outside the system, the PBX telephone switch sends your data via modem.

■ An RS-232C patch box connection scheme is good for sharing serial devices like printers.

*Centrex* is a similar service offered by your local telephone company. Instead of installing a PBX in your building, the phone company lets you share its big switch downtown and use it as your own. This sharing scheme can have significant advantages in reduced up-front costs, reduced maintenance costs, improved growth potential, and excellent reliability.

The types of Centrex services offered vary widely around the country. The most sophisticated use digital telephones and digital transmissions throughout the system. Older Centrex installations (like older PBXs) are analog voice systems that use modems to move data. Local telephone companies view Centrex as a way of holding onto business customers who might otherwise bypass their services, so installing a digital Centrex service will probably be more popular than upgrading a PBX system. If your organization uses Centrex, you should ask the phone company that installed it whether it also offers data communications. The latter service is often referred to as a Central Office Local Area Network, or CO LAN.

Prices for these systems vary widely. Full-featured digital systems can cost more than $1,000 per port to buy or an equivalent monthly amount to lease.

**SIMULTANEOUS ACCESS** Although circuit-switching schemes allow basic file and equipment sharing, they do not offer the most sophisticated and effective form of data sharing: simultaneous multiuser access. Allowing multiple users simultaneous access to the same data files without overwriting or destroying one another's work is a network's toughest job, but it pays the greatest dividends in increased productivity. One example of this type of access would be an airline or hotel reservations system, in which clerks are constantly inputting data and requesting information from the central database. They need to do both quickly, and more than one clerk may need to refer to the same record at the same time.

Three categories of systems give users simultaneous access to the same data files: local area networks, minicomputers, and mainframe systems. Even though these systems use very different connection schemes, the distinction between them can grow fuzzy. For example, several local area networks use fairly powerful minicomputers as network servers. But without splitting hairs, let's take a look at these sharing alternatives.

**LOCAL AREA NETWORKS** As mentioned before, workstations in a PC LAN rely on a permanent physical connection between workstations but take turns using the media. This scheme allows PC LANs to share resources while still maintaining the benefits of local processing with a few caveats.

Most LANs today are used to exchange files, but this purpose alone would not justify paying the average installation cost of about $1,000 per workstation. Although sharing expensive equipment like laser printers and vertical plotters is probably the best economic justification for installing a LAN, using a LAN to access a multiuser database will probably yield the greatest productivity plan.

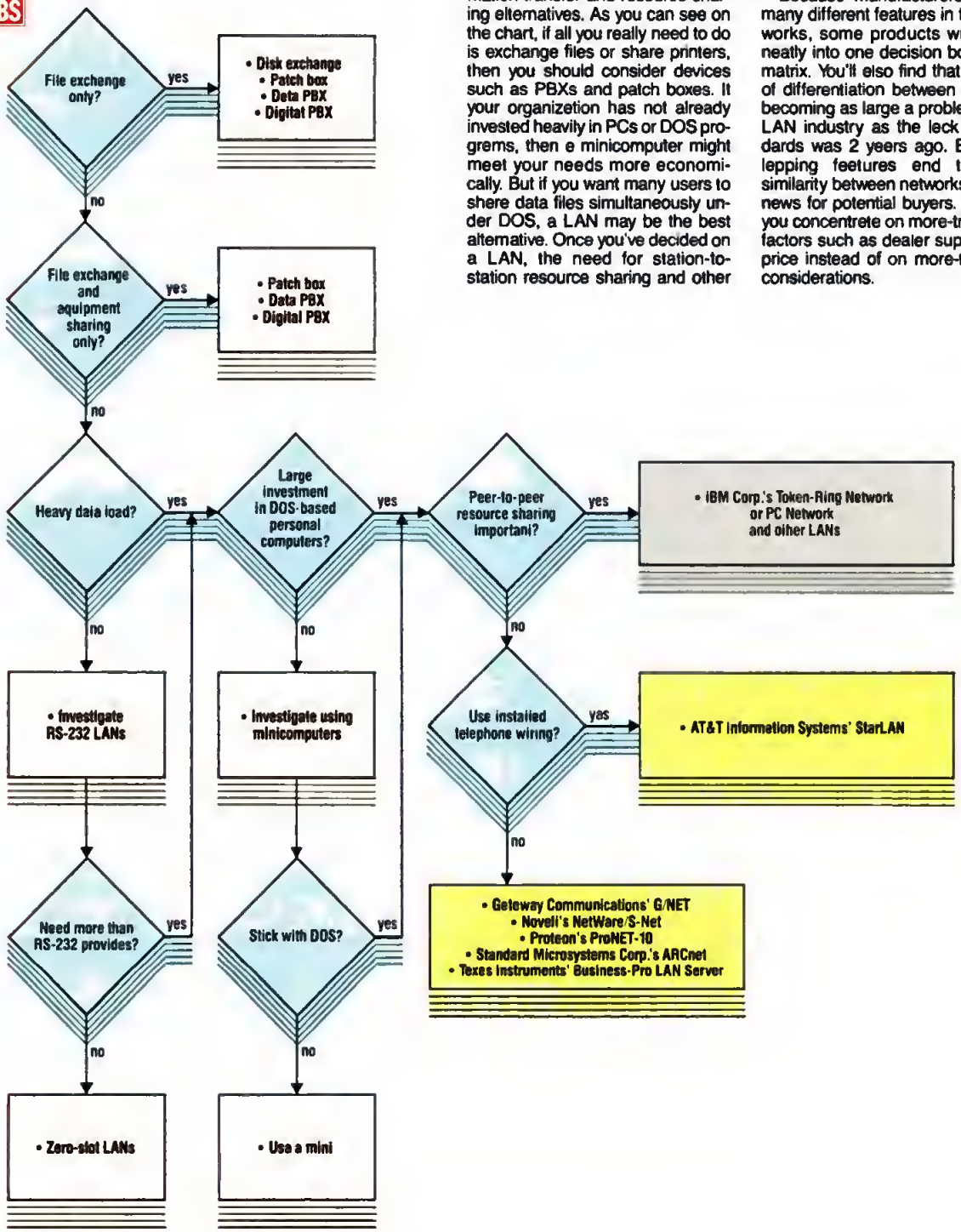
Consequently, the most important factors in choosing a LAN relate to the applications programs and the network software that allows you to run them (see "The Software Key to LANs"). Other factors to consider include the type of wiring (or media) used. Wiring can be a major factor in the installation cost of the LAN. The electrical environment in which your system is installed determines the kind of wiring you should use. The physical configuration (topology) of the network affects how easy the system is to maintain (see "Connectivity: LANs and Beyond").

Because the network software and

# The Connectivity Decision Guide

This chart is designed to help you select from among the many information-transfer and resource-sharing alternatives. As you can see on the chart, if all you really need to do is exchange files or share printers, then you should consider devices such as PBXs and patch boxes. If your organization has not already invested heavily in PCs or DOS programs, then a minicomputer might meet your needs more economically. But if you want many users to share data files simultaneously under DOS, a LAN may be the best alternative. Once you've decided on a LAN, the need for station-to-station resource sharing and other factors will influence your network purchasing decision.

Because manufacturers include many different features in their networks, some products will not fit neatly into one decision box in this matrix. You'll also find that the lack of differentiation between LANs is becoming as large a problem in the LAN industry as the lack of standards was 2 years ago. But overlapping features and technical similarity between networks is good news for potential buyers. It will let you concentrate on more-traditional factors such as dealer support and price instead of on more-technical considerations.



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## ■ NETWORKING OPTIONS

hardware are so closely interwoven with the operating system and interrupt hardware of the PC, potential incompatibility and conflicts may arise on several levels. We have found networking cards that could not be on the same bus with certain models of video boards, networking software that would not coexist with RAM-resident programs, and processors that literally ground to a halt under the network load. Our experiences should serve as a warning that installing and maintaining a network requires considerably more than just plugging in some cards and hooking up a few cables.

**MINIS AND MAINFRAMES** In a permanent, hard-wired connection scheme, like that between terminals and minicomputer or mainframe systems, the host computer switches messages or data between terminals and devices almost on a bit-by-bit basis. But the media is neither shared nor switched.

A mainframe or minicomputer may be the best choice if you need to establish several simultaneous sessions for database inquiries, electronic mail, and other jobs. These systems are also efficient for long, dedicated file transfers and for fast, highly interactive operations such as databases. In addition, they can store huge amounts of information.

Mini and mainframe computers use multiuser operating systems (which today's PC-DOS is not) with their dedicated connection schemes, although some large mainframe installations may use contention and queues to allocate access ports. These operating systems can handle the file- and record-sharing, security procedures, electronic mail, and other essential features that are needed in a multiuser computer system. Unfortunately, some proprietary multiuser operating systems offer few compatible applications programs. One appeal of the UNIX operating system is that it can run on multiuser computers from many different manufacturers. Like that of the DOS 3.1 networking standard, UNIX's broad base attracts applications programmers.

Both the price and size of powerful multiuser minicomputer systems are shrinking like brand new Levis in hot water. Companies such as Digital Equipment Corp., NCR Corp., Convergent Technologies, and IBM Corp. are offering minicomputer solutions that have cost advantages over PC LAN systems for as few as three or four stations—provided that you don't already have a major investment in PCs, software, and data files.

These companies are also developing systems that will allow interactive computing between PCs linked together on a network and larger hosts. This age of invisible interaction between local PC and remote host programs is 1 or 2 years away, but as it nears it will displace some of the appeal of today's LANs.

**OLD PROBLEMS** While offering the benefits of sharing databases, files, and equipment, powerful LAN systems and mini and mainframe hosts resurrect many of the old data processing problems. The main problem is programming backlog in corporate ADP installations. Standalone micros short-circuit this problem by making you responsible for your own programming. But by adding the layers of software for a multiuser system (LAN, minicomputer, or mainframe), you increase the need for frequent modifications to those layers, and hence create the potential for a programming backlog.

Other rediscovered concerns include security risks, accidental pollution of the database, lack of standardized formats for data, slowdowns caused by overloading the computing power, and the need to standardize screens and menus.

Modern networking and multiuser computer software should be designed to help you avoid or cope with these and other problems. A large part of our evaluation is aimed at finding out how much of a programming and administrative workload the network creates.

**LOOKING AHEAD** This overview of information-transfer schemes has contrasted several different ways to move data. As you've probably surmised, local area networks aren't a perfect economic or operational fit for many applications, but they are a reasonable solution for a wide variety of tasks. If you have considered the alternatives and think a PC LAN might meet your needs, follow us as we explore the products in the marketplace. PC

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CONNECTIVITY:
First in a Series of Reviews

# MAKING CONNECTIONS

# LANs Under NetWare

**Complexities plague even the best of LANs. To guide you through, we review and benchmark-test six networks running Novell's networking software to show how these systems stack up under the toughest real-life conditions.**

**COVER STORY**
FRANK J. DERFLER, JR.

PC MAGAZINE

Late one night, in a room smelling of hot hardware and cold pizza, a lonely PC Labs technician cried out, "So many things can go wrong!" While many people can identify with that lament, it is the theme song of every local area network evaluator. Slightly different versions of DOS on the network stations, bad cables, bad connections, and one improper keystroke by someone who signed on with the supervisory password can all bring a network to its knees.

Although we were well aware of the obstacles, last May PC Labs began the grueling task of evaluating local area networks. In this issue, we give you the results of our testing for six products running under Novell's *NetWare* networking software: AT&T's StarLAN, Gateway Communications' G/NET, Novell's NetWare/S-Net, Proteon's ProNET-10, Standard Microsystems Corp.'s ARCnet, and Texas Instruments' Business-Pro LAN Server. Since it is the networking software that largely determines the way the product appears to the user, we included a review of *NetWare*. (Our results indicate that many of the differences between the products tested are related more to the version of *NetWare* used than to variations in the hardware.) We will continue to provide evaluations of other networks running under different vendors' networking software in future issues.

## OFFICE AUTOMATION

PC Labs designed the tests of local area networks to exercise the products in a true-to-life manner. Generally, busi-

nesses use PC LANs for two purposes: office automation or transaction processing. Office-automation tasks combine a heavy word processing load with spreadsheet, graphics, and some database work. The transaction processing environment uses database applications programs for such functions as inventory control, accounting, and customer support.

Each of these functions exercises the network in different ways that we try to simulate in our evaluations and benchmark tests. People working in an office frequently switch tasks and look for different bits of information with their PCs. Phone calls and visitors interrupt office workers and change their priorities. They may change tasks and/or their desks frequently and should be able to access their own programs and files wherever they move.

A network serving the office environment must, therefore, be flexible and easy to reconfigure. The software must work with RAM-resident programs such as *SideKick*, transfer files between workstations easily, and furnish office productivity tools like electronic mail. Since office networks seldom transmit large amounts of data at once, speed is not a major factor as long as the system meets some minimum level of efficiency.

**TRANSACTION PROCESSING** The opposite is true in transaction processing. While flexibility may not be a big consideration for a transaction-processing application, speed and capacity are crucial. The work is more likely to be structured than creative, and in many types of network systems with 12 or 15 workstations sharing a PC AT–type server, the amount of work created can be enough to cause a significant communications backlog.

The way you judge a network will depend on your individual application. The applications software, networking software, workstations, the server, and network interconnection devices add different pieces to the performance of the network as a whole. For example, while many of the networking software features determine the flexibility of the system, the interaction between hardware and software determines its speed. Our tests, therefore, try to exercise these pieces individually and together to determine their effect on net-

## Benchmark Test: LANs Under NetWare

The critical factor for all of these benchmark tests is the speed degradation that the network demonstrated under load. Some networks, such as the Ethernet-based Texas Instruments system, executed the standard tests quickly under lightly loaded conditions but slowed down under heavier loads. The token-based ARCnet system from Standard Microsystems and the directly connected NetWare/S-Net system from Novell did not start out fast, but they degraded only in small, predictable steps under load.

### Network Speed Under Contention Test

**Performance Times** (Times given in seconds and decimal seconds)

| Product | Zero Stations | One Station | Two Stations | Three Stations | Four Stations |
|---|---|---|---|---|---|
| Business-Pro LAN Server | 41.11 | 88.07 | 109.87 | 129.49 | 153.48 |
| G/NET | 54.65 | 74.20 | 85.84 | 106.25 | 134.20 |
| ProNET-10 | 58.96 | 64.48 | 68.60 | 92.25 | 124.27 |
| NetWare S-Net | 71.00 | 83.70 | 94.29 | 103.71 | 115.68 |
| StarLAN | 58.41 | 70.12 | 75.68 | 81.86 | 93.46 |
| ARCnet | 59.45 | 82.14 | 67.83 | 78.21 | 92.56 |

### Network plus Server Cruncher Test

**Performance Times** (Times given in seconds and decimal seconds)

| Product | Zero Stations | One Station | Two Stations | Three Stations | Four Stations |
|---|---|---|---|---|---|
| ProNET-10 | 58.96 | 82.50 | 125.12 | 143.37 | 200.30 |
| StarLAN | 58.41 | 80.47 | 112.00 | 131.26 | 158.65 |
| G/NET | 54.65 | 81.02 | 98.02 | 122.31 | 145.77 |
| ARCnet | 59.45 | 65.85 | 73.87 | 110.65 | 128.63 |
| Business-Pro LAN Server | 41.11 | 54.43 | 82.63 | 93.47 | 104.85 |
| NetWare/S-Net | 71.00 | 73.05 | 79.45 | 86.87 | 91.00 |

### Smart Applications Test

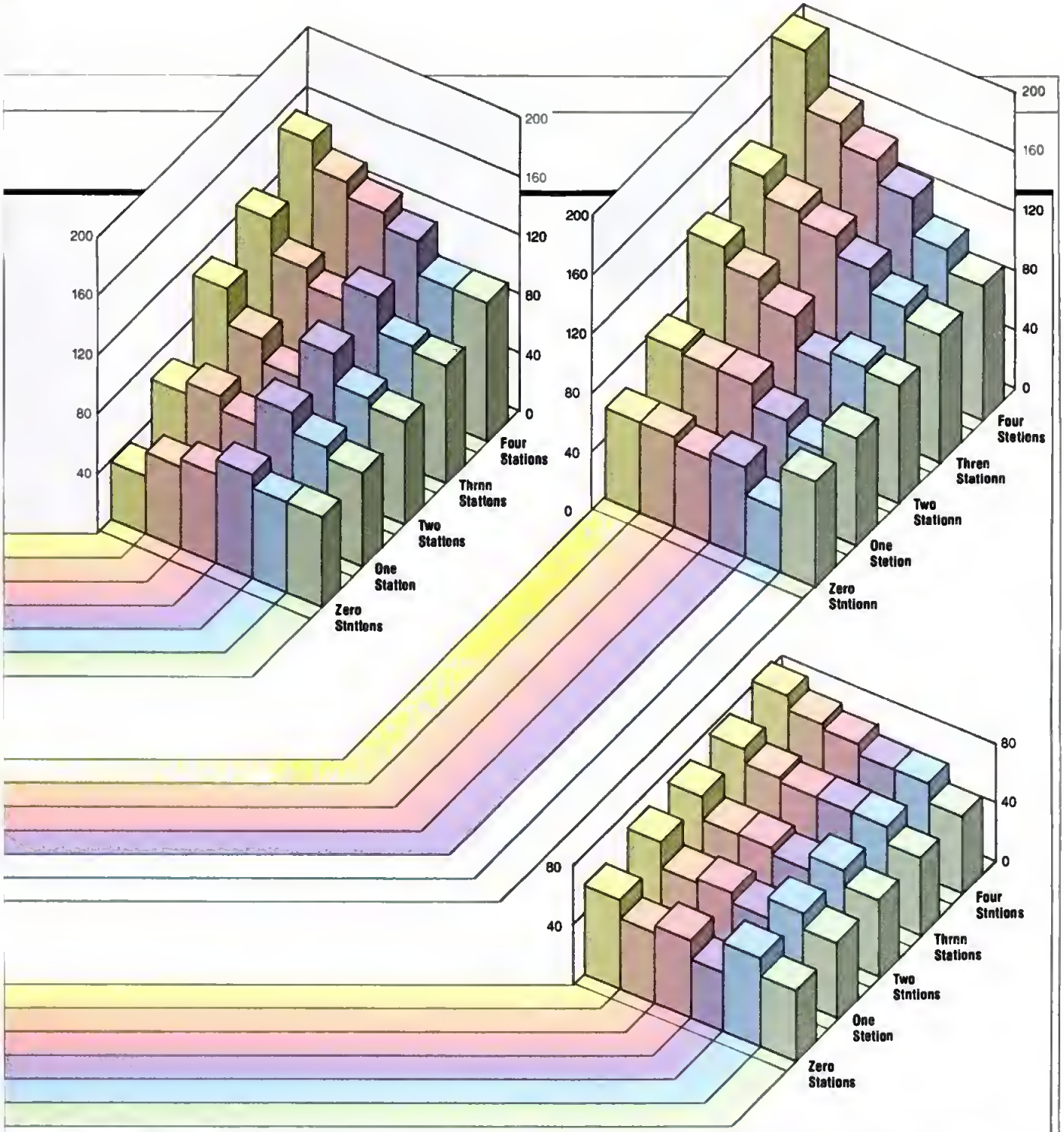
**Performance Times** (Times given in seconds and decimal seconds)

| Product | Zero Stations | One Station | Two Stations | Three Stations | Four Stations |
|---|---|---|---|---|---|
| G/NET | 80.07 | 70.00 | 73.00 | 77.00 | 85.00 |
| ProNET-10 | 46.50 | 52.50 | 57.50 | 87.00 | 75.00 |
| StarLAN | 51.50 | 54.50 | 58.50 | 63.00 | 72.00 |
| Business-Pro LAN Server | 41.00 | 47.50 | 52.00 | 62.00 | 65.00 |
| NetWare S-Net | 61.00 | 61.00 | 62.00 | 63.00 | 64.00 |
| ARCnet | 47.00 | 49.50 | 49.50 | 50.50 | 50.50 |

PC Labs used the same 8-MHz IBM PC AT as the server for the benchmark tests on the Gateway, Proteon, Standard Microsystems, and AT&T networks. Texas Instruments and Novell provided their own servers for their networks. We configured all of the servers to operate only in the dedicated mode and not as dual-purpose server/workstations. The benchmark tests were run using a network of three IBM PCs, one IBM PC AT, and one IBM PC-XT as workstations. All networking software was installed using the default configurations. No attempt was made to "fine-tune" the buffers or other parameters to achieve better performance in any one test.

For both the **Network Speed Under Contention** and **Network plus Server Cruncher** benchmark tests, the dependent variable is the time it took for the IBM PC-XT on a LAN to perform a standard set of DOS read-write commands against a single data file residing in the server. The independent variable was the network load. We began with the heaviest load, four network workstations running DOS batch files, asking for constant reads of data files from the server. Then we decreased the number of stations one by one to reduce the network load.

The three-dimensional chart on the right shows the time it took the XT to perform the test under the varying network load on each network. For comparison, we give the time it took to run the same test on the XT's internal hard disk (Zero Stations).




The difference between the Network Speed Under Contention test and the Network plus Server Cruncher test lay in the size of the deta blocks that the workstations moved over the network.

The Network Speed Under Contention test exercises the network when the network interface cerds and the media are heavily loaded. We attempted to eliminate the factor of server disk access time from this test by loading the network with deta blocks small enough to reside in the server's cache memory on most systems. In eddition, we varied the size of the data files to detect any cache limits.

The Network plus Server Cruncher test heevily loads the network interface cards, the media, and the server'n disk drive access system. In this case we used deta blocks of verious sizes, some smell, some large, when we loaded the network in order to exercise the hard disk drive access system. The results are influenced by hard disk performance and the efficiency of the networking soltwere as it moves data on the disk and between the disk end the network interface cards.

During both of these tests, we used a hardware clock residing on en AST Six-Pack card in the XT to determine the starting and ending times. We did not use the system clock because its operation can be disturbed by some network functions.

The *Smart* series of integrated networked programs from Innovative Soltware gave us a practicel way to evnluate networks under the load of typicel epplications. In fact, viewed on a system monitoring screen, such as *NetWare's*, the **Smart Applications** benchmark test looks and acts like a busy office, because the level of activity varies between intense use of the network and quiet periods when processing takes piece.

For the dependent variable plotted on the three-dimensional chart, we used an IBM PC-XT operating Innovative Soltware's *Smart DBMS* running a script file that indexed and sorted shared database records. The independent veriable wes one through four workstations running another script from Innovative Soltware that created bursts of ectivity interspersed with periods of silence.

work efficiency and performance.

We dedicated a standard testbed of six machines—three PCs equipped with dual floppy disk drives, one XT, and two new 8-MHz ATs—to the task. If a network vendor did not provide a specialized server, one AT acted in that function. At some time during every test, we rotated a Zenith Z-150 and an ITT Xtra in place of a PC to test the compatibility of the network with non-IBM hardware.

In order to maintain more consistency in the testing, the same team of reviewers evaluated every product. And because it isn't possible for these reviewers to test the products at the same time, we froze as many variables as possible to ensure the integrity of the tests, then tested the networks one at a time.

The following are the factors upon which *PC Magazine* based its network evaluations. For each of these factors, we gave each LAN a rating of poor, fair, good, or excellent. You'll find the results in the table, "LANs Under NetWare: Summary of Features." The benchmark tests, which evaluated the systems' speed with varying numbers of workstations, can also be found in this article.

**TURNKEY INSTALLATION** Some vendors give you all the equipment you need to get up and running on two, three, four, or six workstations, including customized disks ready to boot on each machine. Our evaluation indicates whether turnkey installation is available and indicates the amount of work involved in installing such a sytem. We gave an excellent rating to a system requiring nothing more than "plug and play."

**MENU-DRIVEN INSTALLATION** Many companies have developed their own tutored or menu-driven installation system. An excellent menu-driven installation program carefully describes or illustrates any hardware switch or jumper settings required, explains the process of configuring workstation disks (if required), and suggests default settings for all selections.

**DOCUMENTATION** Even with menu-driven programs, you need good documentation. Excellent documentation includes a table of contents, a good index, a glossary, illustrations, and accurate instructions.

**NETWORK ADMINISTRATION** All networks require some daily or weekly attention to configure the software to meet the changing needs of the user. Based on our experience with the product, we estimated how many hours the network administrator would spend monthly to perform the following tasks:

- Create two new workstation boot disks.
- Add ten new subdirectories for network users.
- Transfer ten files from each of five directories into five new subdirectories.
- Re-tailor the log-in scripts or batch command files for ten users.
- Reconfigure the spool files and change any drivers needed for one new printer.
- Change all passwords once.
- Change all of the system parameters that are required to arrange the number of files that can be open at any one time.
- Redefine user rights to five subdirectories.

**NETWORK STATUS REPORTING** Every station should be able to access information about the active users on a network and the devices available for common use. The network supervisor should have detailed information on network performance and problems. To gain an excellent rating, the network supervisor should be able to determine the following:

- The percentage of network server CPU utilization
- The number of bad transmissions over a time period
- The activities of individual stations
- The status of shared peripherals

**SECURITY** Security is critical for transaction-processing applications, such as inventory systems. A security system should do more than simply allow or deny access to files. An excellent system allows the supervisor to designate different levels of access to each user, ranging from the ability to read-only through the ability to add to, delete, and create files.

**WORKSTATION OPERATION** Users address networking programs through DOS-like commands or through menus. PC Labs rated the interfaces' features and ease of use for nonsupervisory users. To earn an excellent rating, the system should have menus or a command structure similar to *1-2-3*, in which you put the cursor on the command and hit Enter or type the first letter of the command. Systems with good pull-down menus and icons (like *Microsoft Windows*) would also qualify.

**STATION-TO-STATION TRANSFER** Businesses commonly cite the need to transfer text or spreadsheet files from the local disk drive on one station to that of another as one of their reasons for purchasing a LAN. This is a LAN application in which speed is secondary to ease of use. We evaluated the ease or difficulty of this procedure subjectively and gave higher ratings to networks that allow direct, station-to-station transfer of data than to those that require moving data between subdirectories on the server.

PC MAGAZINE EDITOR'S CHOICE

***ARCnet has been available since the 1970s, and in Standard Microsystems' version of ARCnet for the PC, experience and quality go hand in hand. ARCnet is easy to install, resists degradation under heavy loads, and assures successful data transmissions by including an error-checking and retransmission protocol. Other LAN vendors that understand technology and look for reliable performance repackage ARCnet boards with their systems. For example, Novell uses ARCnet boards to extend its NetWare/S-Net system. In addition, ARCnet interface cards marketed by several different manufacturers work together without a hitch. Although we also love the hardware of Novell's NetWare/S-Net, the Standard Microsystems package combined with a modern 80286 server offers more flexibility at a lower cost and with similar performance.***

**PRINTER SPOOLING/QUEUING** Printer sharing is another important reason for purchasing a LAN. We tested the products by creating three print jobs on three different workstations and sending the output to the system printer nearly simultaneously. We then evaluated printer spooling and queuing on functionality and ease of use.

Excellent printer-sharing capabilities allow unmodified applications programs (such as a word processor) to send their output to COM1 and then to spool and queue the work without further intervention by the user. The spool and queue should not be destroyed if the printer should happen to fault.

■ Using the LAN to communicate, instead of passing notes or making phone calls, can enhance productivity in an office.

**PEER-TO-PEER COMMUNICATIONS** Using the LAN to communicate, instead of passing notes or making phone calls, can enhance productivity in an office. Communications between stations take two forms: electronic-mail programs, which store and forward messages, and real-time messages, which replace telephone calls. These forms of communications serve very different needs, and both must be present in the system and operate effectively for the system to earn an excellent rating in our tests.

**NETWORK DIAL-IN** The ability to call into the network through a modem is valuable in office systems. This feature lets the network automatically answer incoming calls, allowing access to the network from within the limits of security and the tele-

## LANs Under NetWare: Summary of Features

| Product/ Manufacturer | Installation: Turnkey | Installation: Menu-driven installation | Installation: Documentation | Network Administration: Hours per month | Network Administration: Status reporting | Network Administration: Security | Network Administration: Workstation operation | Features: Station-to-Station file transfer | Features: Printer spooling/ queueing | Features: Peer-to-peer communications | Features: Network dial-in | Compatibility: RAM-resident software | Compatibility: *Smart* software | Compatibility: *dBASE III Plus* | Compatibility: *R:base Series 500* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **StarLAN** AT&T Information Systems | ○ | ■■■■ | ■■■■ | 1.00 | ■■■ | ■■■ | ■■■ | ○ | ■■■ | ■■■ | ● | ● | ● | ● | ● |
| **G/NET** Gateway Communications Inc. | ○ | ■■■■ | ■■■ | 1.25 | ■■■ | ■■■ | ■ | ○ | ■ | ■■■ | ● | ● | ● | ● | ● |
| **NetWare/S-Net** Novell Inc. | ○ | ■■■■ | ■■■■ | 1.00 | ■■■ | ■■■ | ■■■ | ○ | ■■■ | ■■■ | ● | ● | ● | ● | ● |
| **ProNET – 10** Proteon Inc. | ○ | ■■■■ | ■■■■ | 1.00 | ■■■ | ■■■ | ■■■ | ○ | ■■■ | ■■■ | ● | ● | ● | ● | ● |
| PC **ARCnet** Standard Microsystems Corp. | ○ | ■■■■ | ■■■■ | 1.25 | ■■■ | ■■■ | ■■■ | ○ | ■■■ | ■■■ | ● | ● | ● | ● | ● |
| **Business-Pro LAN Server** Texas Instruments | ○ | ■■■■ | ■■■■ | 1.00 | ■■■ | ■■■ | ■■■ | ○ | ■■■ | ■■■ | ● | ● | ● | ● | ● |

PC—Indicates Editor's Choice. ●—Yes ○—No

Excellent—■■■■ Good—■■■ Fair—■■ Poor—■

Few differences exist between the products evaluated in this table because all ran under some version of Novell's *NetWare*. The only real differences, such as G/NET's lower rating for ease of use, stem from the absence of some menus in the older version of *NetWare* provided with the system. Installing new workstations with the G/NET and ARCnet systems took slightly longer then with the other systems because the boot program must be customized for each workstation in these systems.

phone line without any dedicated hardware except the modem and serial port. We tested this function using a Hayes modem connected to the server (if possible) or another network station. We also tested the function under heavy network load to discover speed degradation in the communications port or the network.

**COMPATIBILITY WITH RAM RESIDENTS** RAM-resident programs such as *SideKick* and *ProKey* enhance office productivity. PC Labs tested whether the network would run RAM-resident programs by loading *SideKick* and *ProKey* into every workstation during startup. Then we tried to use the RAM-resident programs while the workstation was communicating with the network. If we encountered no problems, we noted that the system was compatible.

**SMART SOFTWARE TEST** We tested for compatibility between *The Smart Software System* integrated package and the network. In addition, we used *Smart* to test the network under the load of a normal application. For speed results of the *Smart* test, as well as other benchmark timing tests, see the PC Labs benchmark tests results in this article.

**dBASE III PLUS TEST** We also performed a test for compatibility between the widely used *dBASE III Plus* networked DBMS (database management system) and the networking software. In addition, our workstations attempted to simultaneously read, append, and sort, in order to test the software's file- and record-locking operations.

**R:BASE 5000 TEST** We tested for compatibility between the widely used *R:base Series 5000* networked DBMS and the networking software. Several of our workstations read, appended, and sorted the same record to test the software's file and record locking.

**AND ON TO THE REVIEWS** For a more detailed discussion of the pieces that make up each network, how you set up and configure them, the features they include, and more, read on. The reviews of each product are included in this section.

# Novell's NetWare

Orem, Utah—far from Silicon Valley or Boston's Route 128 corridor—is hardly a place where you would expect to find a hotbed of computer activity. But Orem is the home of the most successful maker of networking software for PCs. Novell claims that over 44,000 LANs serving more than 300,000 workstations run under the LAN software they call *NetWare*. More than 20 companies, including all those whose products are reviewed in this issue, sell Novell's *NetWare* with their network hardware. The newest versions of *NetWare* also allow for its installation on many networks that come with their own software, such as those of IBM Corp., AT&T Information Systems, and 3Com Corp.

**MANY NETWARES** Novell currently markets three versions of *NetWare*. *Advanced NetWare/86* runs on most networks with servers that use the 8086/88 processor. *Advanced NetWare/286* has modifications that allow the 80286 microprocessor in the IBM PC AT and AT compatibles to run in protected mode, in which it can use extended memory efficiently. And *SFT NetWare (System Fault Tolerant NetWare)* allows the software to continue functioning in the event that one or more of the system components fail. In addition, *NetWare* comes conveniently adapted to and bundled with many other vendors' network hardware.

Like all networking software, *NetWare* is really a series of programs. The thick package of disks in the distinctive red Novell box includes electronic mail, security, status monitoring, printer spooling, tutorial, on-line help, and other programs that are optional or unavailable on some other LAN systems.

**FUNCTIONS OF NETWORKING SOFTWARE** There are two primary functions of all networking software: network input/output and disk management. The software must exchange data with the network interface and allow multiple workstations to use the server's disk drive capabilities.

Novell has a large library of driver programs that control network I/O and can work with network interface cards from many vendors. To install the driver for your system, you simply select the appropriate driver from a menu. Some network vendors preinstall the drivers when they bundle *NetWare* with their hardware.

*NetWare* uses several techniques that improve network function by improving the performance of the server's hard disk drive. A *directory-hashing* technique indexes directory entries according to a mathematical formula for fastest retrieval. *Elevator seeking* is the unlikely name for a well-planned feature that looks beyond the immediate movements of the disk drive head and arranges the next ones in the most economical manner. And *NetWare*'s *disk-caching* system can significantly improve performance by storing several sectors of

PC MAGAZINE

FACT FILE

***Advanced NetWare/86***
***Advanced NetWare/286***
***SFT NetWare***
Novell Inc.
1170 N. Industrial Park Dr.
Orem, UT 84057
(801) 226-8202
**Requires:** 40K RAM, DOS 3.1.
**Prices:** *Advanced NetWare/86*, $1,595; *Advanced NetWare/286*, $2,195; *SFT NetWare*, $2,995.
**In Short:** A well-integrated and advanced LAN software system that contains features other vendors are still struggling to develop. Not copy protected.

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# *EasyLAN*—Networking For Less Than $100 Per PC

*STOP* buying expensive duplicate PC peripherals. Usually your peripherals just sit idle. If your office owns two or more PCs can you justify costly laser printers for each PC? How often are your printers actually busy? Thirty minutes a day? An hour a day? Even your expensive hard disks are used infrequently.

The obvious solution to avoid expensive duplicate peripherals is a local area network that allows you to share printer and disk drives. But until now LANs have cost in excess of $1,000 per PC.

**THE *EasyLAN*™ OFFICE NETWORK**

*EasyLAN* shares printers and disk drives between IBM PCs. *EasyLAN* can save you $1,000 or more per PC by eliminating duplicate equipment purchases.

**EasyLAN HIGHLIGHTS**

- ***EasyLAN* shares printers, plotters, data, and disk storage**
- **PC to PC file transfer**
- **Print spooling**
- **New PBX support**
- **Easy to install**
- **Easy to operate**
- **Modem support**
- **Performs in the background**

*EasyLAN*'s low price matches the small business user's cost-sensitive budget. It is the office network solution for less than $100 per PC including cables and software for a 2-PC or 3-PC network.

*EasyLAN* performs its operations concurrently in the background. *EasyLAN* communications, file transfers and printer operations all take place while each PC simultaneously performs such normal DOS applications as Lotus 1-2-3,™ WordStar,™ and dBASE.™

**NEW PBX SUPPORT**

New PBX support allows *EasyLAN* to transfer data files and share peripherals between PCs using PBX circuit switched connections and twisted pair wiring. *EasyLAN* has already been installed on a number of different PBX systems and has been certified by Northern Telecom on the Meridian SL-1.

*EasyLAN*'s performance meets your small office or department requirements to move word processing documents and spread sheets between PCs. For example, *EasyLAN* can transfer a 10-page document between PCs as a background operation, in less than one minute.

*EasyLAN* loads automatically at boot time. It manages the PC's serial and parallel ports for communications and printing.

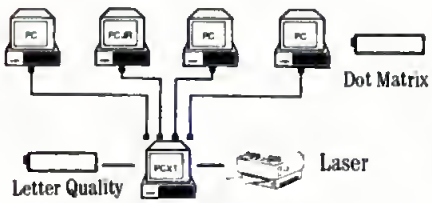
*"The value is high.* 🖳🖳🖳🖳*"*
**—InfoWorld Report Card**

Printer sharing operates transparently with existing programs. Print files are automatically spooled to disk and scheduled for printing. Multiple printers per PC may be designated for specific office tasks.

*"I bought access to a laser jet printer for $80."*
**—CONOCO Oil User**

Disk sharing uses *EasyLAN*'s EZCOPY command to move files to and from PCs ASCII or binary files can be transferred in the foreground, or in the background while other DOS programs run.

All communication operations are protected by a unique password assigned to each PC so security is maintained.




***EasyLAN* Office Network**

***EasyLAN* SPECIFICATIONS**

Each PC in the network requires an individual licensed copy of the *EasyLAN* program and takes 20k of memory on each satellite PC, a serial port, and DOS 2.0 or above. *EasyLAN* disks are not copy protected. *EasyLAN* runs on all IBM PC models and Compatibles. The HUB PC requires a serial port for each satellite PC. The COM2 and COM6 boards are serial port expansion boards which permit you to add serial ports to the HUB PC.

**EASY TO INSTALL**

*EasyLAN* can be installed in less time than it takes to enjoy your coffee break. Just plug the *EasyLAN* cables into existing serial ports. The *EasyLAN* Network Configuration Program provides a menu driven installation program that will guide you step-by-step through the software installation process.

**EASY TO ORDER**

*EasyLAN* is a proven product with over 12,000 installations. To order just call toll free **800/835-1515.** Start with a two PC network and expand as your needs demand.

*"If it does all you need why spend more? It is the ultimate example of practicality in a local area network."*
**—PC Magazine**

**PRODUCT SUPPORT**

We take pride in our quality product support. *EasyLAN* support is provided over the telephone by the same people who installed over 12,000 networks last year.

*"I look for products that make my job easier and save my company money. EasyLAN does both."*
**—Mini Micro Magazine**

## *EasyLAN*

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In CA **408/738-8377**
For Configuration Assistance & Technical Questions
Call 408/738 8377

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**Dealer Inquiries Invited**

Name _____
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State _____ Zip _____
Telephone (_____) _____

Payment: Visa, MasterCard, Check, COD, Bank Draft

Name on Credit Card _____

Cr. Card No. _____ Exp Date ___/___

Server Technology, Inc., 1095 East Duane Ave. #103
Sunnyvale, CA 94086 Telex 5106003481

| Item | Description | Price | Qty | Amount |
|---|---|---|---|---|
| EL 01 | *EasyLAN* Kit—for 2-PCs 30′ cable, two disks & manuals | $179.95 | ___ | $ ___ |
| EL 02 | *EasyLAN* Expansion Kit—for 1-PC 30′ cable, one disk & manual | $109.95 | ___ | $ ___ |
| EL 11 | *EasyLAN* disk & manual (3½″ disk $89.95) | $ 79.95 | ___ | $ ___ |
| EL 12 | *EasyLAN* 30′ cable | $ 49.95 | ___ | $ ___ |
| EL 13 | COM2-serial port expansion board, two ports | $219.95 | ___ | $ ___ |
| EL 14 | COM6-serial port expansion board, six ports | $489.95 | ___ | $ ___ |
| EL 15 | Custom length cables, call for quote | | | |
| | CA res add applicable sales tax | | | $ ___ |
| | Shipping charge USA $10.00, other $20.00 | | | $ ___ |
| | **TOTAL ORDER** | | | $ ___ |

CIRCLE 520 ON READER SERVICE CARD

data from the hard disk in a memory buffer. These features are important because, typically, networks are not limited by the speed of transmission through the media but by requests for access to the server's hard disk.

*NetWare* formats the server's hard disk drive in a manner very different from the formatting used by DOS. You can, however, partition the disk so that a portion remains in DOS format should you wish to use the server as a local workstation. Because of the unique disk formatting, only specified machines can be servers on a Novell network. In contrast, products such as *Tapestry* (from Torus Communications, New York City) or IBM networking software allow any workstation to work as a server, contributing such resources as a hard disk to the network. Novell's approach achieves better performance and security, while versions of the shared-resource approach such as those used by IBM and *Tapestry* improve LAN flexibility and facilitate redundancy for backup.

**SYSTEM SECURITY** Networking software commonly provides system security. Under *NetWare*, the system administrator can either allow or deny individual users the ability to read, write, create, delete, search, and modify files. You can choose to assign passwords or not, and you can easily change passwords and permissions using commands or menus.

Wise system administrators make sure passwords are protected and frequently changed—a precaution that Novell considers very important. Unlike most other network operating systems, Novell's system is arranged so that no one can access the files except through the password and security system. So, a vandal or snoop can't view or edit the disk files merely by gaining physical access to the server and rebooting it under DOS.

**SPECIAL FEATURES** Other *NetWare* features make your network more than just a way to swap files. *Advanced NetWare* responds to the file- and record-locking commands of DOS 3.1. Therefore, database-management applications such as *dBASE III Plus* or *The Smart Software System* can give multiple users access to the same files without corrupting the database. We benchmark-tested the operation of *dBASE III Plus*, *Smart*, and *R:base Series 5000* running under several versions of *NetWare*. While our tests were not exhaustive, we ran many of the commonly used file- and record-locking routines and received the right DOS 3.1 responses from the *NetWare* operating system. *NetWare* also includes a NETBIOS emulation module for applications that make direct calls to the Microsoft NETBIOS (see networking software article—"A Software Key to LANs").

A common reason for purchasing a LAN is to allow several workstations to share one or more printers. The print spooling capabilities of network software allow workstations to send files to the server, which then routes the file to a designated printer. The printer spool queues the jobs waiting for a printer and then sends them to the printer, along with all of the formatting, graphics, form-feeds, and other instructions from your applications program. Earlier *NetWare* versions required you to issue an awkward "end-spool" command to send your job to a printer, but *Advanced NetWare* handles spooling and printing smoothly. It also creates a header for each job to help route it back to the right person when a printer is shared by many users.

*NetWare* also features an electronic-mail system that comes installed and is ready to run when you bring up the server. The electronic-mail system allows you to exchange files, documents, letters, and memos. Documents are usually word processing files containing formatting information, letters are straight ASCII files, and memos are short notes typed on-line.

*NetWare*'s mail system works well and the commands are simple, but the format isn't intuitive or obvious. Instead of responding to menus, as in conventional mail systems such as MCI Mail and CompuServe, you enter commands as text. A special context-sensitive help system is supposed to evaluate your request for help and make an appropriate response, but the responses aren't always helpful. New or infrequent users will either need to study a book or be trained to use the mail system.

## SNIPES: A LITTLE NETWORK FUN

*Novell has included the shoot-'em-up maze game Snipes in its networking software to let programmers have some fun as they administer the network.*

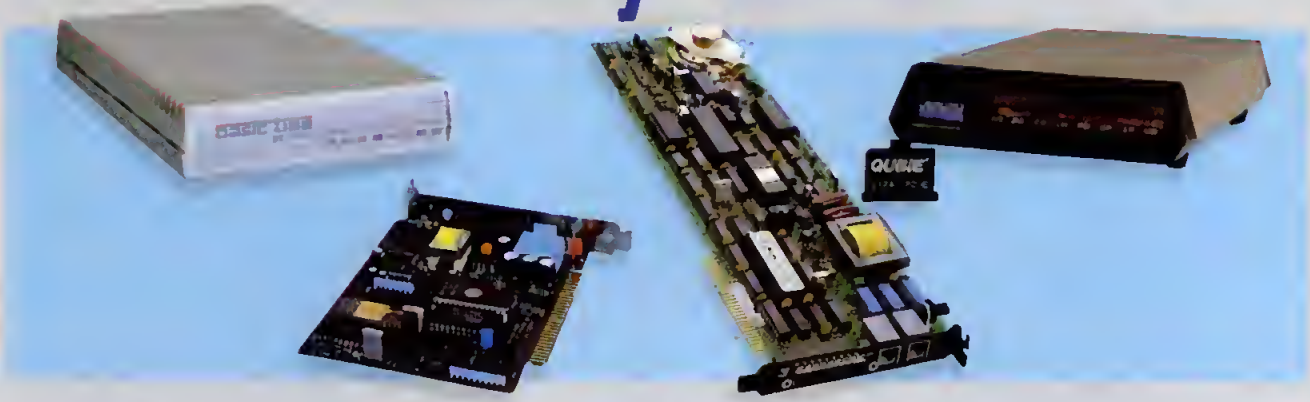
On mainframe computer systems, it's not uncommon for software companies to include "programmer's treats" with a commercial application or operating system. The best known treat for bored programmers is the original game of Adventure. This tradition has carried over to the microcomputer industry. *WordPerfect*, for example, includes a game called Beasts with its library system. And now networks have the bug, too, with Novell's inclusion of the popular game Snipes in its *NetWare* networking software.

Snipes is an addictive shoot-'em-up maze game. You use the keyboard to move around a large maze while dodging enemy fire and shooting the snipes as they threaten your existence. To keep players in view, you can pan around the maze. In the networked version of Snipes, called NSnipes, many people can play in the same maze. That makes the game even more fun, because players on different workstations can team up to hunt snipes or play against each other to settle programming grudges. Even on the network, screen I/O is so fast that you see the action as quickly as if you were the only player. And if you want to challenge yourself, NSnipes offers different levels of play, giving you such options as deadly walls and ricocheting bullets and allowing you to vary the aggressiveness of your opponent.

It's nice to see that Novell likes to serve up a little fun with its network.

**—Ed Halbert**

# Family Affair



*Choose from a family of 4 modems -- the 1200 baud modems at $139 & $149, and the 2400 baud modems at $299 -- that offer unbelievably great performances and make you wonder why everyone else charges so much!*

**2400 Baud Modems**
Internal Modem: Modular Phone Cable, Mounting Bracket, COM1 or COM2, Asynchronous Communications
External Modem: AC Power Adapter, Stand Alone Enclosure, Status Indicator LEDs, Asynchronous Or Synchronous Communications
Both Units: Hayes Compatible Command Set, CCITT V 22/V 22 bis and Bell 212A Compatible, 110/300/600/1200/2400 bps Operation, Automatic Adaptive Equalization, IBM PC Hardware Compatible, Two RJ-11C Jacks (Alternate Voice/Data Communication)

**1200 Baud Modems**
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Both Units: Bell 103/212A 300/1200 Baud, Fully Hayes "AT" Command Set Compatible, Modular Phone Cord, PC-TALK III Software

## Pedigree

You can be sure that the Qubie' family of modems are of good stock. Our latest editions, the 2400I Internal Modem Card and 2400E External Modem are proof positive what good breeding can accomplish. These state-of-the-art modems are CCITT V.22/V.22 bis, Bell 212A Compatible, and 2400/1200/600/300/110 bps.

Our modems are fully compatible with all Hayes software commands. Software packages such as Crosstalk, Smartcom II, and Sidekick will work flawlessly. Both the 2400I and 2400E are equipped with Automatic Adaptive Equalization which automatically adjusts to the telephone line and increases performance and decreases the error rate.

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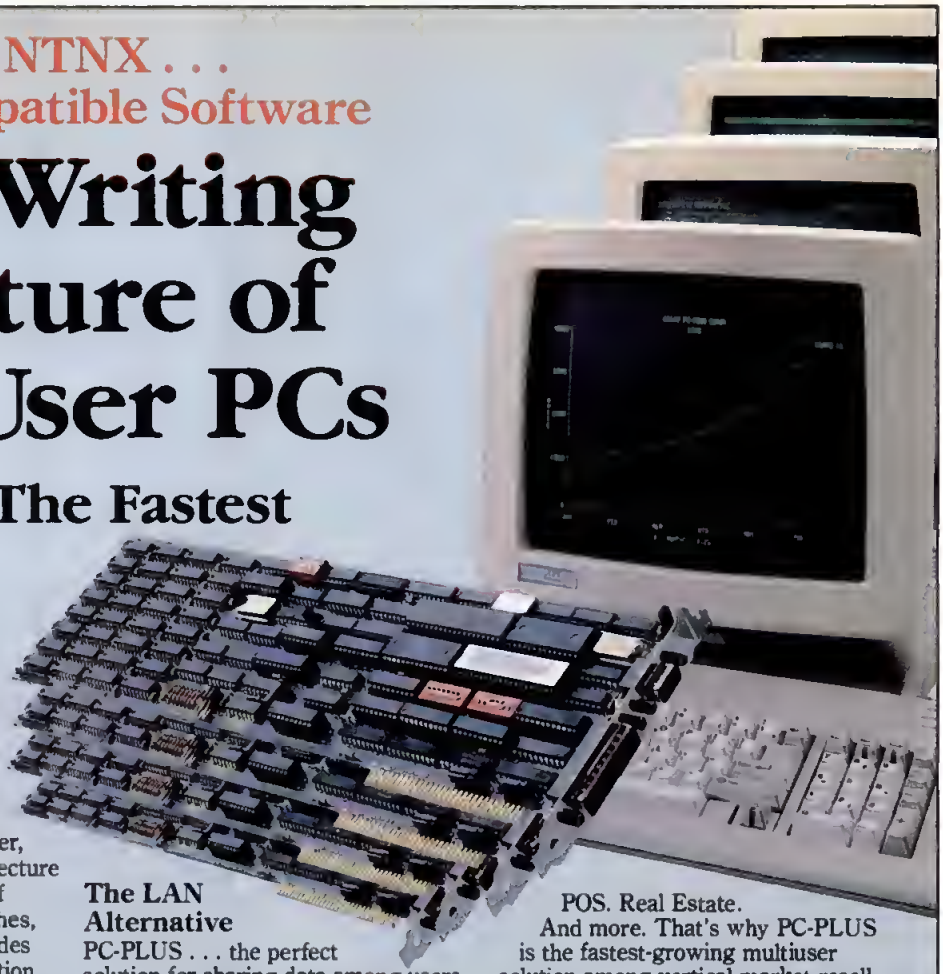
CIRCLE 235 ON READER SERVICE CARD

## Now Shipping NTNX . . .
## Network-Compatible Software

# We're Writing the Future of Multi-User PCs

## PC-PLUS — The Fastest Growing Multi-user PC Solution



**1984** Alloy introduces PC-PLUS — a revolutionary multiuser, multiprocessor architecture for PCs. Amidst the confusion of LANs and time-sharing approaches, RTNX and PC-SLAVE/16 provides a unique, high-performance solution. What LANs promised, PC-PLUS delivered. Faster. Easier to install and use. Less Expensive.

**1985** ATNX with its lightning-fast disk caching supports AT-class machines. File and record locking — plus controls to manage file access. Disk volumes greater than 32 Mb. DOS 3.X machines can reach the peak of multiuser performance.

**1986** NTNX and PCST/G graphics terminal continue the tradition. NTNX lets PC-PLUS run multiuser applications written for Novell NetWare and MS-NET. PCST/G brings high-resolution, Hercules-compatible graphics to PC-PLUS workstations.

**AND BEYOND** We've written the history of multiuser PCs, and we're writing the future . . . with PC-compatible multiuser systems.

### The LAN Alternative

PC-PLUS . . . the perfect solution for sharing data among users. The 8MHz SLAVE/16 card operates at over twice the speed of typical PCs. Advanced bank-switched memory delivers data at bus speed. Many times faster than LANs. Engineering ingenuity makes PC-PLUS simpler and much easier to install than LANs or UNIX multiuser systems. While sharing disks, printers and other peripherals with single-user ease of operation.

### The Optimum IBM Multi-user Solution . . . Made Possible by Alloy

The PC-PLUS family turns your single IBM personal computer or compatible into a fully integrated office solution. Up to 31 users can be added to the host — while maintaining full functionality of the PC. As needs grow, add more PC-SLAVE/16 cards and low-cost terminals.

### The Choice of Vertical Market Resellers

PC-PLUS expands as business grows. In any vertical market. Law. Finance. Medicine. POS. Real Estate. And more. That's why PC-PLUS is the fastest-growing multiuser solution among vertical market resellers. Today with a strong commitment to tomorrow.

### The PC-PLUS is available from:

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**Alloy Computer Products, Inc., 100 Pennsylvania Avenue, Framingham, Massachusetts 01701. (617) 875-6100, TWX: 710-346-0394**
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CIRCLE 345 ON READER SERVICE CARD

**STATUS REPORTING** Network monitoring and status reporting are important features of any network operating system. The network administrator should be able to see a variety of displays reporting on file system operation, as well as factors like the average time taken to complete various types of requests from each workstation and the frequency of requests from individual workstations. Network managers need this information to make good decisions about allocating resources, adding equipment, and troubleshooting. Unfortunately, status reporting is one area in which the entire LAN industry falls down.

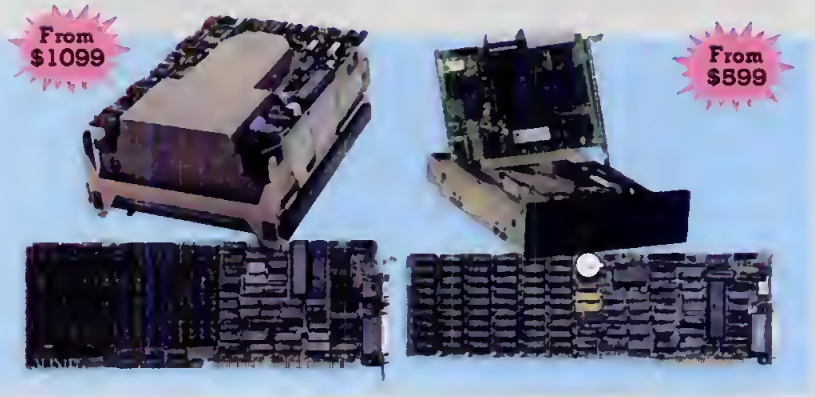
Novell offers a display that runs on the server and monitors file activity on six workstations at a time. This display shows disk actions waiting in queue and the percentage of occupied versus idle time of the server processor. *NetWare*'s displays will tell a network administrator if things look "normal," but it won't help him optimize his use of the LAN. Generally, Novell's network analysis tools are as good as most and better than some, but nonetheless they are barely adequate for the proper management of modern systems.

**TUTORIAL** One of the most laudable features of *Advanced NetWare* is its tutorial system. The tutorial comes on three disks that you must load onto a hard disk. *AutoMentor* tutoring software is a program that facilitates the creation of on-screen instruction sessions using the actual programs being taught. *AutoMentor* runs the program, makes or prompts keystroke entries, and displays annotations over a *NetWare* screen. The result is an effective tutorial describing the menu and operational utilities.

**INSTALLATION** Installing the software for any network is a two-part operation: first you copy the software onto the server(s) and workstations, then you configure the network for operation.

It takes some time to install *Advanced NetWare* on a server properly, but the process is well documented and will be easy if you have ever formatted and partitioned a hard disk. Novell supplies two utilities to test and format the server's hard disk. One test should run for several hours on a large hard disk to evaluate the electromagnetic


# The Great Expanse




***Turn Your Basic PC Or XT Into A Powerhouse With A Qubie' XTKit. Our 1-2 Punch Lets You Create The Ultimate (And Affordable) Enhanced AT.***

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**ATK-1 BT42 & AT4X4Plus (512K) $1099**
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Your AT is no toy -- it's e serinus piece nf computing equipment which requires the finest in peripherals to unleash its power and potential. Qubie' ATKits ere the snlutinns tn turning an unenhanced IBM AT nr competible intn a supercharged system which will run circles arnund the IBM "Enhanced" Models.

A powerful AT needs a berd disk with the cepacity and tbe speed tn supply deta fest. Our BT42 hard drive hes e formatted capacity of 42 megahytes and 30 msec. eccess time. Also included is the "Dreamboard" -- the AT4X4Plus. It has up to 4 megabytes available, e parallel and serial port standard, with 3 mnre seriel ports optional.

**SCOPE**

Savvy buyers bava lnng been awere thet they can eave money by buying e single-drive PC or XT end edd their own multifunctinn cerd end hard disk. Nnw ynu cen get the power ynu need et e price you can affnrd. The BT6Plus has all tha features you expect of a multifunction cerd; 384K nf memory, serial and perellel ports, battery-powered clock/calendar and optional game port ($20). Ynu also gat print spooling and RAM disk softwera. The Qubie' PC20 hard disks offar the best availahle combinetion nf perfnrmence, ease of installetion, and reliability. Idir software completes tbe kit.

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We really gn the distance fnr ynu et Qubie'. But don't just take our wnrd fnr it. Our excluetve **30-Day No Risk Guarantee** speaks fnr itself. Our tnp nntch tecbnical support staff is here to answar any questions ynu might bava during installation or nperation. With nur nne year warranty, ynur satisfaction ts essured; but if enything sbnuld breakdown, our 48-Hnur turneround on warranty repairs will have you back up in no time.

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CIRCLE 236 ON READER SERVICE CARD

# NEW FROM SYSGEN: THE COMPARISON IOMEGA® DOESN'T WANT YOU TO SEE:

*Iomega removable floppy cartridge.*

*New DuraPak removable hard disk cartridge.*

| Bernoulli Box® | Sysgen™ DuraPak™ |
|---|---|
| 10 Mbytes per cartridge | 15 Mbytes per cartridge |
| $1795 for first drive* (plus $280 for bootable controller, for a total of $2075) | $1295 for first drive* (includes bootable controller and installation hardware) |
| Floppy-based technology (average media life expectancy: "hundreds of hours") | Hard disk technology (average media life expectancy: 11,000+ power-on hours) |
| External, desktop-consuming system | Internal, zero-footprint system |
| Large, 8⅛" x 11" cartridges | Pocket-sized 4¼" x 4⅜" cartridges |
| 90-day warranty | Full one-year warranty on drive and media |

Sysgen's new DuraPak gives you all the transportability, security and unlimited expansion that have made removable media so popular—in a smaller, more convenient, more *reliable* format. No wonder it's so widely used in government and military applications: It's a *better* removable mass storage system for the IBM® PC/XT,™ PC-AT™ or compatibles. At an absolutely unbeatable price.

**Want to compare dual-drive configurations?**

DuraPak gives you all the advantages listed above, at prices that make the competition look positively *greedy*: Sysgen's 30 Mbyte dual-drive DuraPak system costs you $2095, *including* bootable controller. Iomega's 20 Mbyte dual-drive Bernoulli system costs you $2695, plus $280 for their controller. And at $3775 for their 40 Mbyte dual-drive system with controller, it's easy to understand why *they* don't want you to see this comparison!

***Like what you see? Find out more: Call our toll-free hotline for your copy of the Sysgen product family brochure, or for the DuraPak dealer nearest you.***

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media on the surfaces of the disk's platters. If you skip this test, you can have the initial installation job done in an hour. But if you have the time, it's a good idea to test the entire disk.

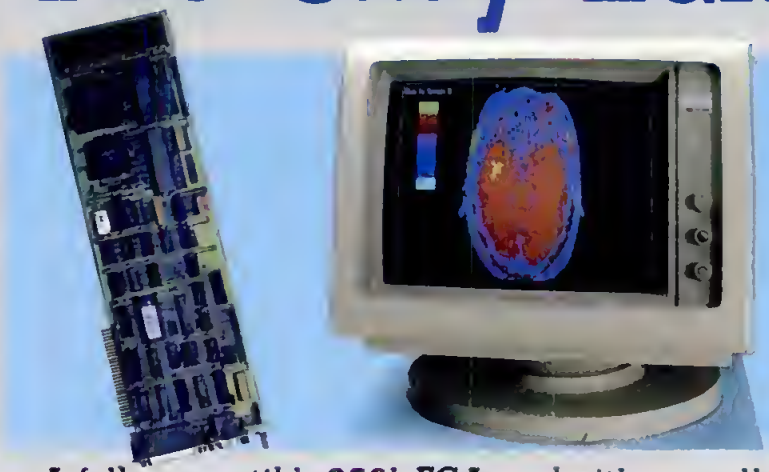
A critical step in the *NetWare* installation process is the creation of the workstation and server *NetWare* BIOS using the menu-driven GENOS (generate operating system) program. The process takes about 12 minutes on a standard PC. For a good part of that time, the PC sits, seemingly idle, while it creates the operating system and drivers used later in the installation. At the end of the GENOS step, you have the files for each workstation and the modified drivers for each server.

The tasks of setting up the server's file structure, establishing security and permission structures, setting DOS paths (called *maps* in *NetWare*), and creating DOS batch files are the biggest jobs facing the network administrator. All networks take work to set up and maintain. *Advanced NetWare* furnishes the system administrator with a detailed multilevel menu to help establish the file structure and security. But the system administrator must have a detailed knowledge of DOS and be able to write the batch files that automatically log people into the system and route them to their active applications and data files.

**EASY TO USE** Several features of *Advanced NetWare* make it particularly easy to use. The latest version of the networking software includes four detailed menus, as well as a utility allowing the network administrator or workstation operator to create personalized menus. The Syscon menu helps the network administrator establish and maintain the security system, control the file structure, and set the ways that applications interact between program and data files. The Session menu allows workstation users to select files and specify how their own files will interact. The Filer menu helps workstation users create, delete, and modify personal files, and allows certain users access to personal files. The Queue menu shows the status of the printing queue and allows workstation users to select one of the three printers that can be on each server.

Another nice feature is that once the sta-


# The Only EGA



*A fully compatible 256k EGA card with a parallel port for only $259. If you buy any display card: Color, Monochrome, Hercules, or EGA, without reading this ad, you're probably throwing away a lot of money.*

**QUBIE' Enhanced Graphics Adapter:** 256k of memory, and parallel printer port. Works with all standard IBM displays, and compatible displays
**5150 Monochrome Display:** Both text and 640x350 bit mapped graphics.
**5153 Color Display:** 640x200 and 320x200
**5154 Enhanced Display:** Color 640x350 16 simultaneous colors from a palette of 64

## A Clear Upgrade Path

This really is the only display board you may ever need. Regardless of what monitor you buy today, this card is a clear upgrade path for the future, and the best choice today, even if you are only going to use a Monochrome Display. This means one board today does monochrome 640x350 bit mapped graphics and text, and provides a clear upgrade path to 640x350 Enhanced Color Display with no change of display board. It also runs with the 640x200, 320x200 Color Display.

## Killer Features

All boards come with a full 256k of memory, and a parallel printer port. That means no extras for later, and 16 simultaneous colors displayed from a palette of 64 colors, and crisp clear text on both Monochrome and Enhanced Color Displays - features or options that are not available on other EGA boards. Since all your current software will run, you're set for today, and prepared for the standard of the future.

## The Display Deal

Of course many of you will want to take advantage of the EGA card right away, so we are offering a special deal when you buy the board together with a Basic Time HR 31-350 monitor - you get both for just $749, or the card only for $259. This means that you can equip all your PC's now and in the future with displays and EGA cards and get the Qubie' "No Risk Guarantee", our one year warranty, and 48 hour turnaround on warranty repairs. The price is the whole price, there are no extras for freight, insurance, or credit cards.

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CIRCLE 238 ON READER SERVICE CARD

tion is connected to the network, *Advanced NetWare* lets you remove the network boot disk from PCs that have only floppy disk drives. Also, *NetWare* does not permanently use workstation RAM. Consequently, once a workstation is connected to the server, *NetWare* becomes invisible and does not impose any overhead on it. Network programs from some other vendors load portions of the workstation program into RAM and keep it there, limiting the size of an application you can run.

Using batch files, the system administrator can make the Novell network act as merely an additional disk drive for the person using the PC. As the benchmark tests show, the *NetWare* software is as fast or faster than any competing products.

**GOOD DOCUMENTATION AND SUPPORT** *Advanced NetWare* comes with a great deal of well-organized and exceptionally good documentation, which includes manuals for half a dozen of the most common hardware systems, as well as separate manuals for workstation operators, installers, and system administrators. Each volume contains its own glossary, table of contents, and index. The installation guides are illustrated with drawings and charts. Beyond this level of support, eight *NetWare* support centers across the country provide good on-call training and technical help.

**WORKS WITH MULTIVENDOR HARDWARE** Once you install the operating system, *Advanced NetWare* allows you to specify up to four different hardware cards for the same server. Thus your server can host a network made up, for instance, of a string of workstations attached to 3Com cards, a string of workstations attached to ARCnet cards, and a string of workstations attached to StarLAN cards. The server could have one card for each, and the differences in hardware would be invisible to the people at the workstations. All users could access the same files and interact through electronic mail. This would be useful when, because of less-than-perfect planning, your company might have networking cards from different vendors.

Novell also sells software that allows a workstation to bridge between two networks, as well as systems that connect workstations to mainframes through IBM's System Network Architecture.

**SYSTEM FAULT TOLERANT** Since failures can occur in many places, Novell's recently released *SFT NetWare* adds a number of features that allow the entire system to continue functioning should one part fail. *SFT NetWare* has redundant directories and special verification procedures when files and the file allocation table are written. It can automatically detect and lock out bad disk sectors without losing data, and it features error detection and correction during transmission through the network.

At the highest level of protection, Novell's *SFT NetWare* can run hard disk drives or even complete servers in the "shadow" mode. This mode performs all actions on both drives or both servers. If one drive or server falters, an automatic reconstruction process takes data from the other unit without halting the network.

Novell has earned its success in the LAN industry. *Advanced NetWare* is the operating system of choice for many manufacturers because it contains many proven features that other networking software companies are still struggling to develop. The power of the IBM name may carry the IBM networking software to strong levels of sales, but *NetWare* will continue to have appeal for its multivendor capability and other well-integrated qualities.

## AT&T Information Systems StarLAN

In the PC marketplace, emulation is the sincerest form of flattery, and AT&T's StarLAN is a much-emulated system. Several companies, notably chipmaker Western Digital Corp., have announced network adapter cards and integrated circuit components compatible with StarLAN. In addition, StarLAN's signaling system has recently been adopted as standard.

This is not a review of StarLAN as AT&T markets it. Because of a shipping problem, we received the StarLAN cards and wiring without AT&T's networking software. Since StarLAN runs under Novell's *Advanced NetWare*, we tested StarLAN using the same software and server as we did for the other LANs reviewed in this issue. And, in fact, Novell recently began selling StarLAN in just this configuration. The graphs in this issue show StarLAN's performance running under *Advanced NetWare/286*, with an 8-MHz IBM PC AT as the server.

In the next issue of *PC Magazine*, we will give you the test results using AT&T's networking software.

As it turns out, StarLAN runs beautifully under *NetWare*. In 15 minutes, we generated Novell server and workstation software for StarLAN using *NetWare*'s GENOS (generate operating system) program. The StarLAN/*NetWare* combination handled network interruption and restoration very well. We used one network station to do a directory listing of the server and then unplugged it from the network. Simply reconnecting the cable restarted the listing right where it stopped. No keystrokes or reboots were needed to restart the workstation's activity.

The StarLAN/*NetWare* combination ran on all of our network's stations, including the 8-MHz AT and several PC-clone systems, without reconfiguration.

**INSTALLATION** Installing StarLAN was surprisingly easy. StarLAN's network interface card is a full-length circuit board with modular connectors—slightly larger than telephone jacks—on the back for plug-in connections to the network wiring. The cards have two jumpers, no switches, and came out of the box ready to install into any long slot on a PC or AT. (They have a little cutout to clear the extra socket in the AT's bus.)

You can physically configure StarLAN as either a bus or a star. But no matter what physical configuration you use, StarLAN always operates electrically as a bus. Not surprisingly, our benchmark tests showed little difference between the bus and star configurations.

All of the workstations access the electrical bus using a CSMA/CD protocol identical to the Ethernet standard protocol. The StarLAN protocol has recently been adopted by the same international standards committee that specified the Ethernet protocol (IEEE 802.3). The pri-

# FOR $49.95, YOU CAN PUT YOUR LAN TO THE TEST.

The new Smart LAN Performance Test is the only software that simulates and measures realistic office use of a Local Area Network.

If you're thinking of buying a network, the Test lets you compare the speed and cost-efficiency of different LANs.

If you already own a network, it lets you judge the effects of adding more workstations, servers, buffers, or memory.

However you use it, the Test gives you the accurate, objective information you need—reported in either worksheet or graphic form.

The Smart LAN Performance Test may be used to evaluate networks running under DOS 3.1, including LANs from 3Com, IBM, Novell, AST, and AT&T. The cost is just $49.95 *(VISA, MasterCard & American Express accepted)*.

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Or write: Innovative Software, attn: LAN Test
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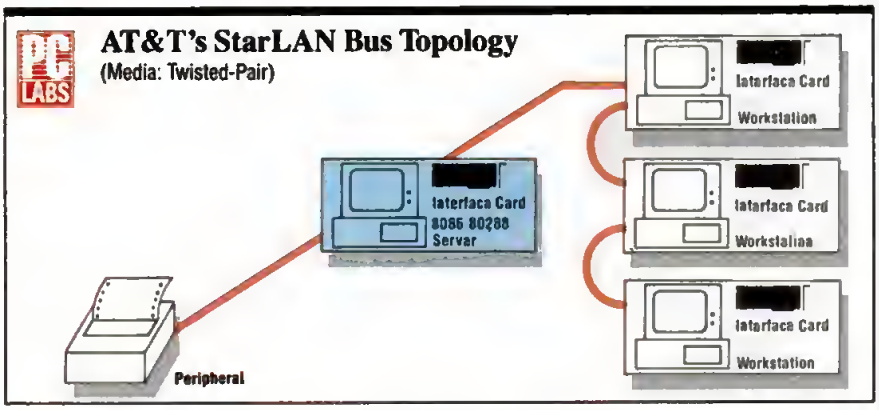


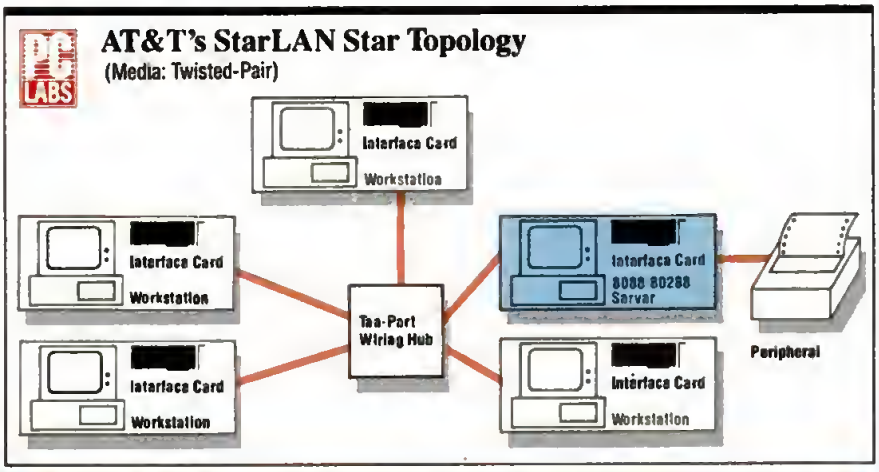


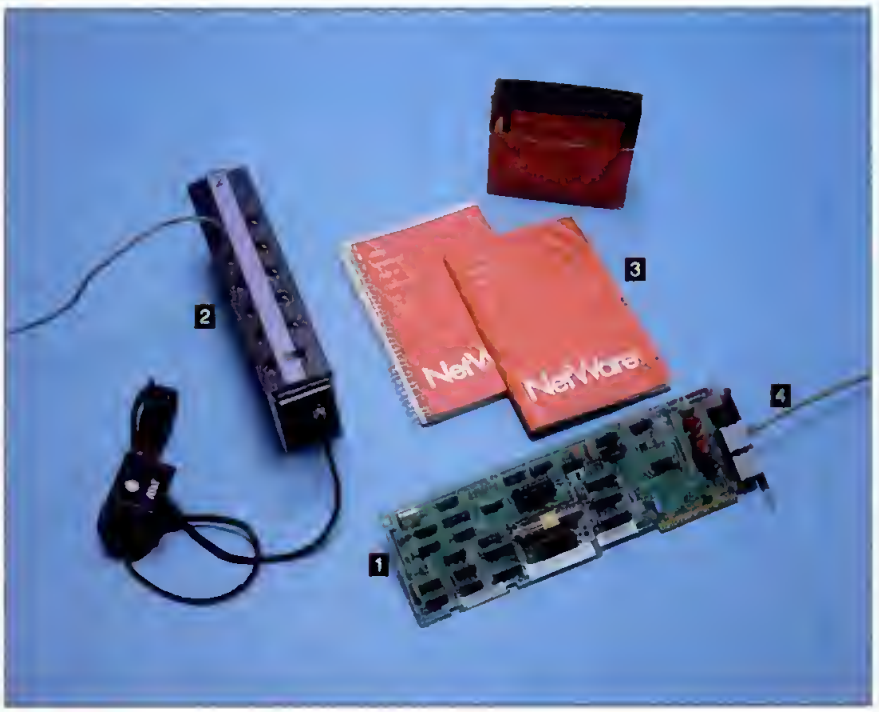


Photographs: Richard Lakin

The StarLAN system consists of (1) a full-length network adapter card for each server and workstation on the network and (2) an optional ten-port wiring hub. An 80286 machine acted as the server tested under (3) Advanced Netware/286. Workstations can be up to 800 feet from a hub. You need a second hub to extend the network beyond that distance or to connect more than ten workstations to the network. Wiring hubs can be up to 10 feet apart. The connecting cable is (4) twisted-pair wiring using modular phone plugs and jacks.

Electrically, StarLAN is a CSMA bus-type system, in which the stations share the wiring by listening before they transmit. Physically, you can connect the workstations together in either a bus, hooked one to the other on either side, or a star, in which all stations are connected to a central hub.

---

mary difference between the two protocols is that Ethernet runs at 10 megabits per second on coaxial cable while StarLAN runs at 1 to 2 megabits per second on twisted-pair wiring.

In the physical bus-wiring configuration, workstations are linked one to the other in a chain. Since you don't have to run wires from each workstation to a central point, as in a star setup, the bus-wiring configuration saves wiring. Up to ten stations can operate in a bus-wiring connected by a maximum of 400 feet of cable. The StarLAN adapter cards have jacks marked "in" and "out." So to configure the bus configuration, you connect the ins to the outs. (For a star, you run the wire from the out jack to a wiring hub.) StarLAN does not require terminating resistors at the ends of the physical bus, as with coaxial bus systems, nor does it require expensive coaxial T-connectors.

The downside to the bus-wiring configuration is that it makes troubleshooting difficult. To locate and fix a problem, you wind up disassembling large portions of the network.

In the star configuration, an active (powered) hub called the Network Extension Unit regenerates packets and allows you to expand and extend the network. You can connect up to ten workstations to one extension unit, then connect extension units to add more stations or extend the distance between stations. You can connect a workstation to a Network Extension Unit with as much as 800 feet of cable.

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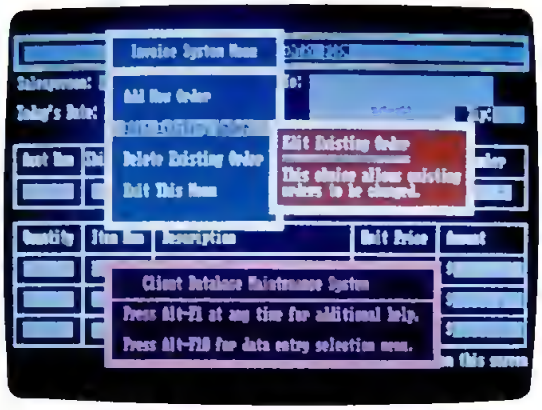

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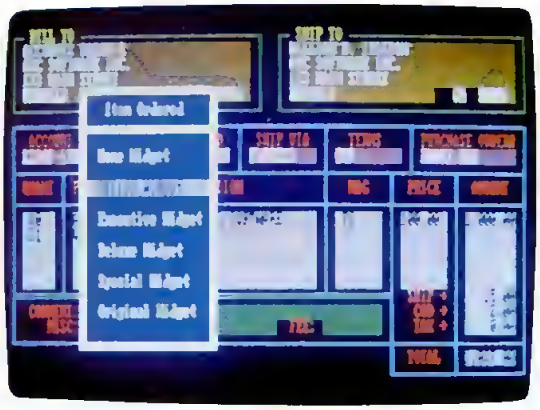

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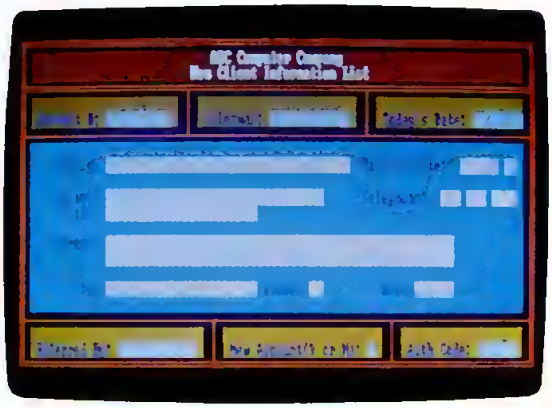

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*If you use a bus connection scheme for StarLAN, the cables run from the out port of one card to the in port of the next. If you use the wiring hub, you connect the cable only to the out port. The telephone port on the interface card lets you connect a telephone to the StarLAN wiring, which contains two pairs of wires, one for voice and the other for data signals. Thus, you can reduce the jungle of wires running from your desk to the wall.*

Although it does not diagnose problems, the Network Extension Unit has features that aid in troubleshooting. When you unplug a workstation from the unit, the jacks automatically close its electrical circuit. If the wiring going to one station is shorted or a station card malfunctions, you can disconnect the station at the hub. To diagnose a problem, you must disconnect each station in turn; when you reach the offending station, the network is immediately restored. Two status lights on the Network Extension Unit blink when the system is working again.

**TWISTED-PAIR WIRING** Most twisted-pair networks use the type of twisted-pair wiring that connects telephones to the wall. But StarLAN's DW8A wiring looks more like coaxial cable. If you are starting from scratch, this cable will probably cost you as much to install as RG-62 or RG-58 coaxial cable. However, the cabling has spare capacity that can be used to carry voice calls to private-branch-exchange (PBX) or key-system telephone switches. StarLAN's network interface card has a jack labeled "phone" that you can use to connect a telephone to a PBX through the StarLAN wiring. In effect, you need only one four-pair cable (about the same size as a single coaxial cable) running to your desk for both voice and data services. Voice and StarLAN data signals don't share wires, but the wires can be located in the same cable until it reaches the wiring closet, where the voice and data wires will go their separate ways.

Another advantage of AT&T's network wiring system is that it can also use the multiconductor telephone cables that are already installed in offices to carry data signals. You'll need to have a telephone installer survey your wiring system to determine whether your telephone wires can accommodate StarLAN's cabling requirements, but many installations can use existing telephone wiring.

**A NICE SURPRISE** Most articles on network cabling advise you to avoid twisted-pair wiring in "noisy" electrical environments. To avoid problems, installations with sparking motors, radio broadcasts, and other sources of electrical interference are advised to use coaxial or fiber-optic cables. Since modern office buildings host a myriad of electrical devices, from air conditioners to floor buffers, we tested StarLAN's susceptibility to interference. Our tests were not exhaustive, but they probably represented the environment found in most small businesses.

We wrapped the StarLAN cable around a small appliance motor that was visibly sparking and looped it around a dehumidifier with both fan and compressor motors running. We also began transmissions over a 3-watt amateur radio operating at 146.52 MHz. We then ran our standard benchmark tests. We detected no difference in performance between tests run in the normal and in the noisy environments.

**COSTS AND SERVICES** StarLAN network adapter cards retail for $595. Other companies have announced compatible cards at prices under $300. The AT&T Network Extension Unit retails for $575. AT&T's networking software sells for $125. The complete Novell *Advanced Netware/286* we used in this evaluation retails for $1,595.

StarLAN is sold through AT&T Information Systems, which has installation, support, and training services available throughout the country.

The StarLAN package offers many flexible installation and expansion options. It will slow down under the heaviest data loads encountered in interactive processing, but its flexibility and moderate costs make it attractive for office automation and light database work.

PC MAGAZINE FACT FILE

**StarLAN**
AT&T Information Systems
1776 On-the-Green
Morristown, NJ 07960
(800) 247-1212
**Workstation Requirements:** 256K RAM, one floppy disk drive, DOS 3.1.
**Network Software:** *AT&T StarLAN Network Program; Advanced NetWare/86; Advanced NetWare/286.*
**Media:** Twisted pair.
**Prices:** 6300 Network Access Unit interface board, $595; Network Extension Unit (passive hub), $575; 300 feet of cabling, $23; 1,000 feet of cabling, $55; Active Link (fiber optic board), $375; Active Link OPT (two-port active hub for PC 200), $1,295; four-port passive hub (for use with PC300), $100; eight-port active hub, $885.
**In Short:** StarLAN is easy to install and expand: the interface cards come out of the box ready to insert and the Network Extension Unit makes it easy to hook up additional workstations. The unit also includes useful status lights that aid in troubleshooting. Although StarLAN uses twisted-pair wiring, the system was unaffected by RF noise.

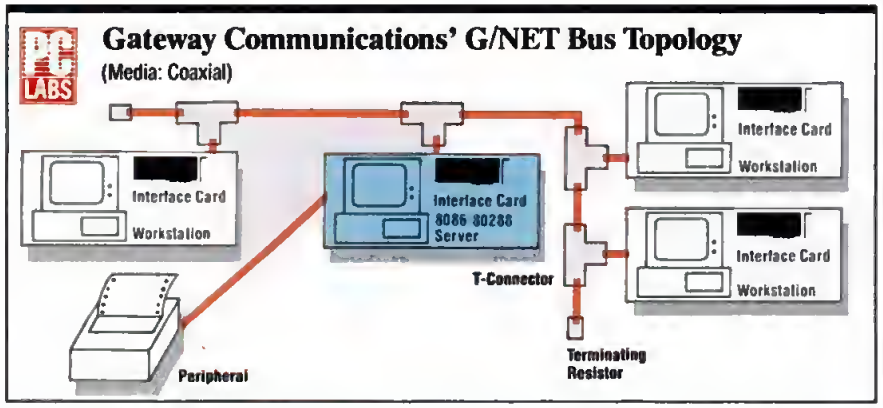
CIRCLE ### ON READER SERVICE CARD

## Gateway Communications Inc. G/NET

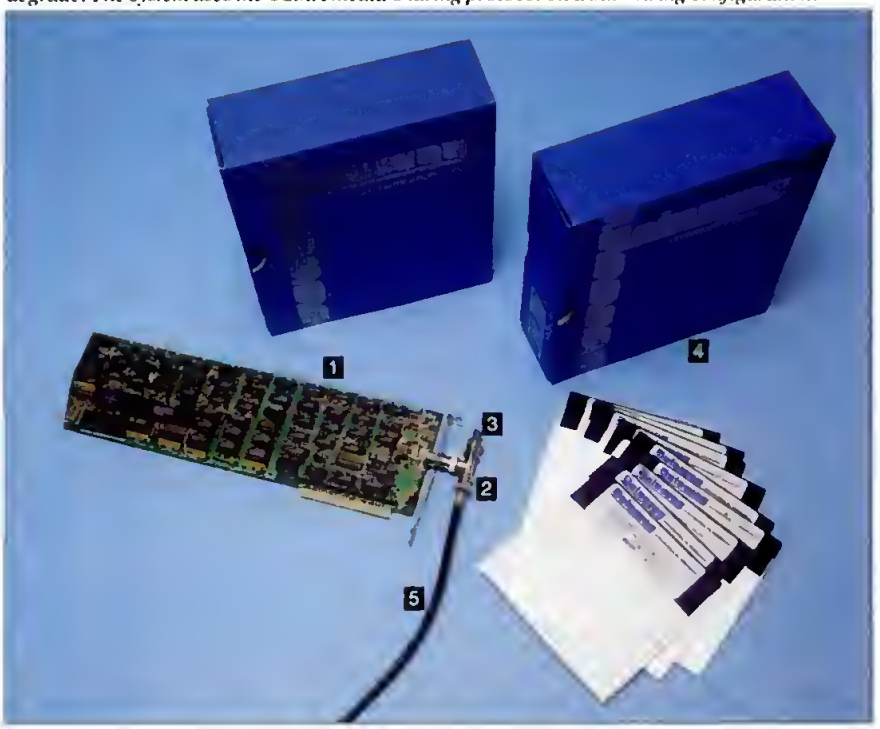
What's dependable, helpful, and reliable? A Boy Scout? No—Gateway Communications' G/NET.

Gateway combines Novell's *NetWare* with its own networking cards and coaxial cable into a bus network. But Gateway distinguishes itself from other network vendors that use *NetWare* by adding utility programs and beefing up the documentation.

Unfortunately, when PC Labs tested G/NET, it came with *NetWare*, Version 1.04, which lacks some of the menus and other features found in later versions of the software. For that reason, Gateway received slightly lower ratings in some areas of the software evaluation than networks that ran *Advanced NetWare*. The manufac-




*Gateway Communications' G/Net system consists of (1) a network interface card for each network station, (2) T-connectors, and (3) terminating resistors. An 80286 machine acts as the server running under (4)* Netware, *Version 1.04. You can use different types of (5) coaxial cable; basically, the larger the diameter, the farther you can run the cable and the less the signal will degrade. The system uses the CSMA media-sharing protocol on a bus-wiring configuration.*




turer assured us that it will supply *Advanced NetWare* by the time this article is published. (Gateway has also announced a version of NETBIOS that will allow the G/NET cards to use the IBM *PC Network Program* software.)

**NOVELL UPGRADES** Unlike most vendors, Gateway requires that you set the base memory address of the network interface card. You have to know the amount of RAM installed in each workstation and change the networking card when you change the RAM size. However, Gateway's custom-installation program simplifies the configuration process by using graphics to show you how to set the switches on the interface card. The program operates in either monochrome or color modes.

All networking software contains lines of code called drivers that exchange data between the network interface card and the computer's microprocessor. Most versions of *NetWare* contain a generic set of drivers meant for all brands of boards. But such generic drivers don't necessarily elicit the most efficient operation from a particular interface board. Gateway therefore substituted its own drivers into *NetWare* to maximize the efficiency of G/NET hardware.

**DATA TRANSMISSION** Data networks of all types, from the international Telenet system to PCs on a LAN, transmit data in packets. Each packet contains addressing, error checking, and other special bit patterns besides the actual data. Most systems also add filler bits to create a fixed-length packet. This method of transmission theoretically ensures each workstation fair access to the network and makes moving packets easier.

Alternatively, a system can use variable-length packets that add only addressing and other necessary bits to outgoing messages. In theory, sending small packets lowers the network's bit-per-second transmission rate, decreases overhead, and improves efficiency. Variable-length packets are believed to work particularly well on PC LANs in which many short

## PC MAGAZINE FACT FILE

**G/NET**
Gateway Communications Inc.
2941 Alton Ave.
Irvine, CA 92714
(714) 553-1555
**Workstation Requirements:** 128K RAM, DOS 3.1.
**Network Software:** *NetWare* 1.04; *NetWare* 4.61B; *Advanced NetWare/86; Advanced NetWare/286;* IBM PC software (requires *G/NETBIOS*, a *NETBIOS* simulator).
**Prices:** Two-node starter kit, $1,895; three-node starter kit, $2,420; additional network interface cards, $525; cabling, $1 per foot.
**In Short:** G/NET is a good general-purpose network. It distinguishes itself from other LANs running Novell's *NetWare* by adding drivers to optimize performance and a program that steps you through the installation procedures. On the downside, under a heavy (but realistic) workload, G/NET was the slowest network tested.

CIRCLE 699 ON READER SERVICE CARD

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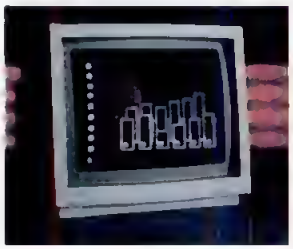

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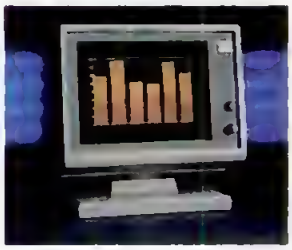

### CASPER GM-1000

**Price**
Mfr's List: **$199**

**Display**
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1000 x 350
High resolution

**Dimensions/Weight**
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Net wt: 8 kgs

### CASPER GM-1230

**Price**
Mfr's List: **$189**

**Display**
12" Monochrome
1000 x 350
High resolution

**Dimensions/Weight**
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Net wt: 7.8 kgs

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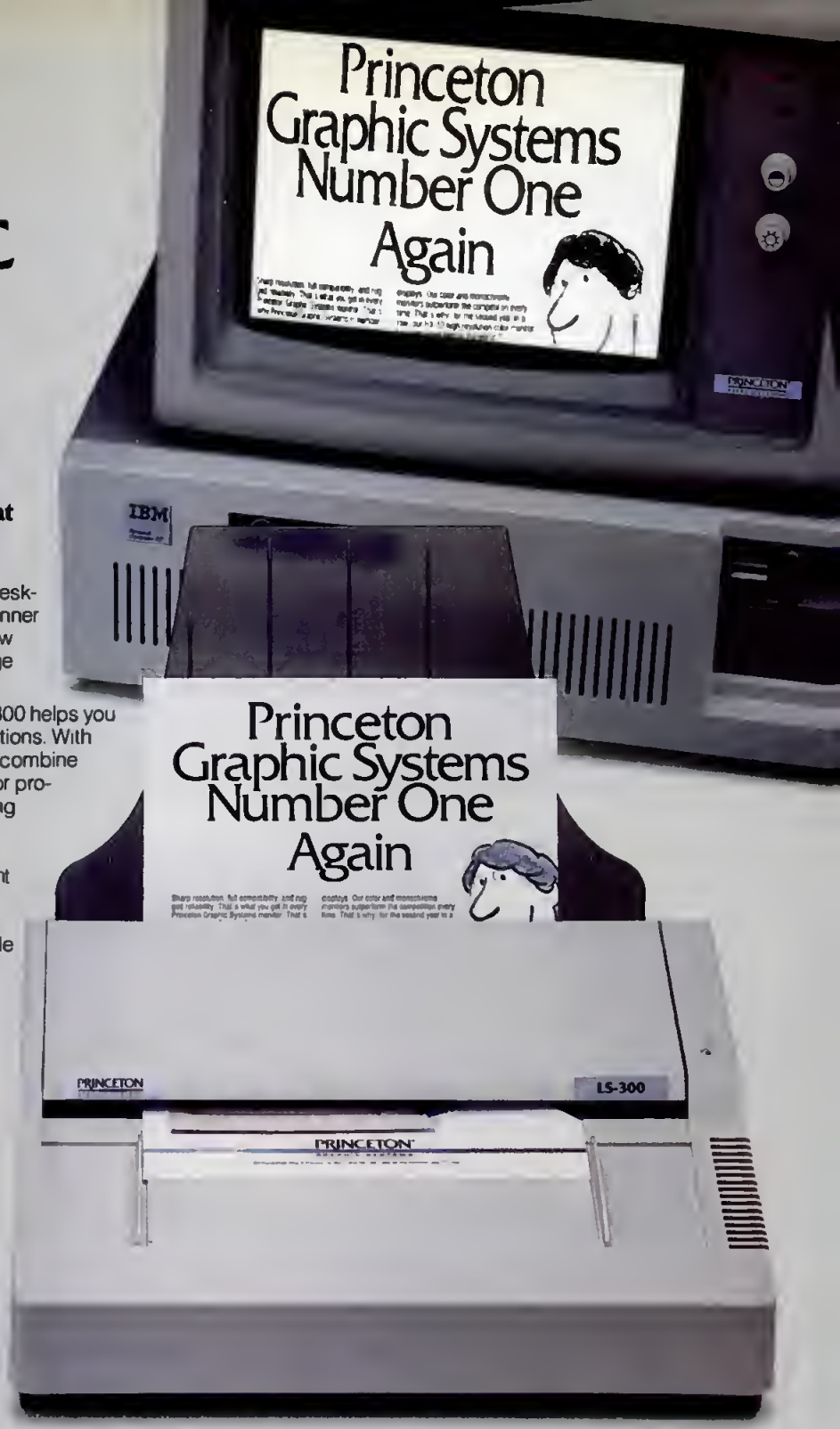


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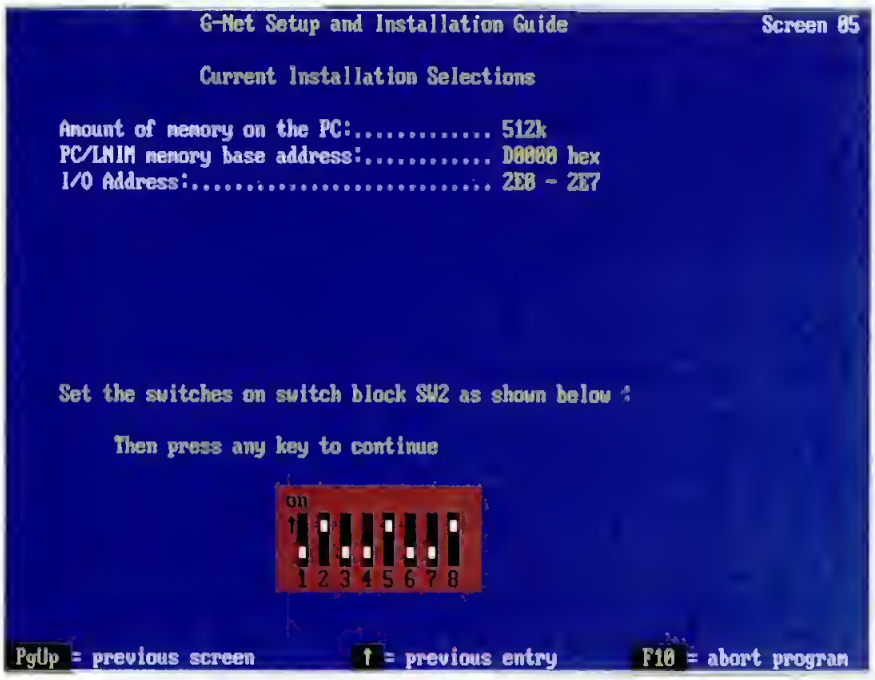



*Gateway Communications' installation program simplifies the process of configuring the network interface card by using easy-to-follow diagrams (see screen shot above) to show you how to set the card's switches.*

messages in the traffic flow are common.

Gateway's revision of *NetWare* allows the system to transfer data in packets varying in length from 1 to 2,550 bytes. But despite its use of variable-length packets, G/NET showed mixed results on the PC Labs speed benchmark tests. In tests measuring the performance of the networking cards and media, G/NET fell in the middle of the pack. Under heavy but realistic workloads, in which we attempted to load both the network and server disk system using *The Smart Software System*, G/NET was the slowest network tested in this issue. This is probably because of the product's use of the older version of *NetWare*.

**G/NET PIECES** G/NET uses the CSMA/CD media-sharing scheme but adds additional error-detection and retransmission protocols. G/NET uses baseband signaling on coaxial cable (the advantage that broadband signaling offers over baseband is the ability to transmit video and data signals simultaneously).

G/NET can use either RG-59/U coaxial cable (75 ohms; used for television), RG-62/U coaxial cable (93 ohms; used for IBM 3270 terminals), or larger-diameter cables such as RG-11, but you can't mix the cable types in a network. A network can use up to 4,000 feet of cable from end to end.

The G/NET network interface boards, each of which has its own Z-80B microprocessor with 64K bytes of RAM, fit into either a PC or an AT expansion slot. The network cable bus connects to the card through a T-connector, so in effect two coaxial leads have to run to every PC except the first and last on the bus. At the end units, you have to install small terminating resistors on the T-connector—a simple but essential job.

G/NET comes with excellent documentation made up of Novell manuals supplemented by Gateway's instructions and hints. Gateway also includes a 2-inch-thick stack of single-spaced technical notes with hints on cable installation, descriptions of new software versions, technical discussions, and other information. Moreover, when we made an unannounced call to Gateway with some technical questions, we got a return call and clear answers. Gateway claims sales of about 15,000 networks containing a total of about 50,000 workstations, and the company has apparently established a good support structure for these customers.

**COSTS** Gateway markets G/NET in two- and three-node starter kits with 25-foot cables and all the software and hardware you need to get started. The two-node kits sell for $1,895, and three-node kits sell for $2,420. Cards for additional workstations are $525. No additional software is necessary to add workstations.

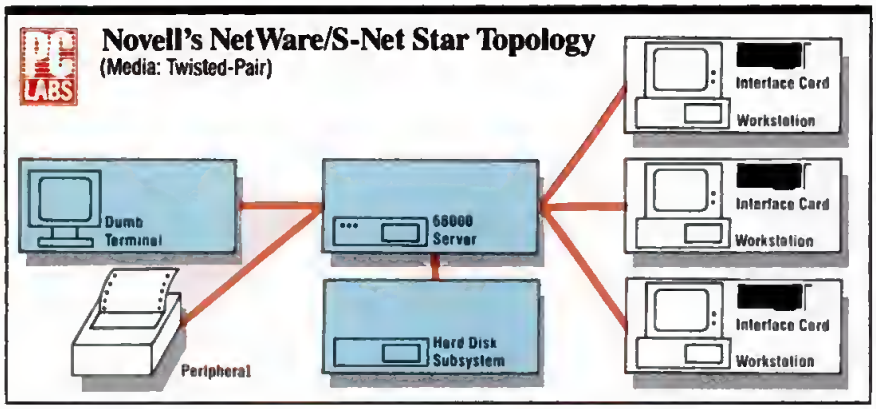
Besides its LAN products, Gateway, as its name implies, offers many products that provide gateway interfaces to other communications systems. You can buy hardware and software packages from Gateway for SNA communications that use 3270 or 3770/RJE emulation, X.25 network communications, and asynchronous modem communications. You could, for example, use these products to link your LAN with a mainframe system.

G/NET is a good, general-purpose network that is relatively easy to install and maintain. But before you invest in the system, make sure that you find out about the availability of Gateway's version of *Advanced NetWare*.

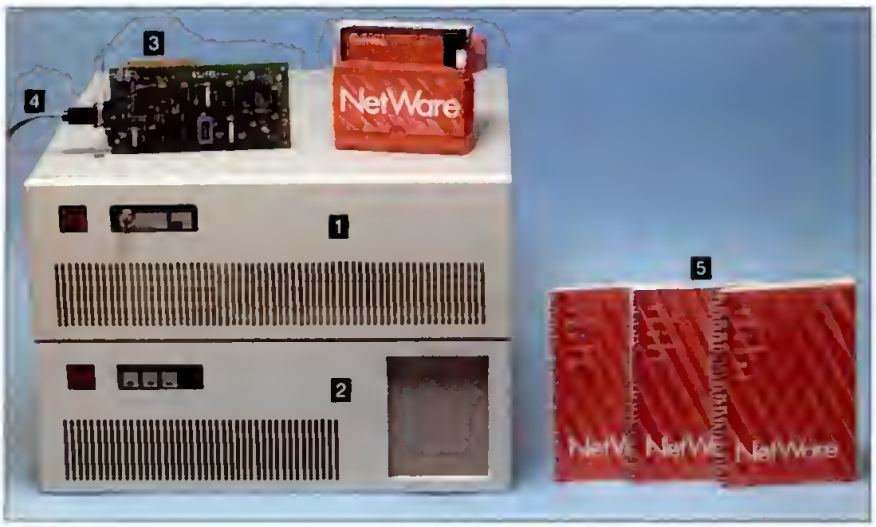
## Novell Inc. NetWare/S-Net

Novell's approach to the LAN marketplace is confusing. On the one hand, the company claims to be primarily a networking software company. Novell networking software is available for several dozen networking systems, including all of the networks reviewed in this issue. On the other hand, Novell also resells networking systems from other vendors, including Proteon, Gateway Communications, and AT&T Information Systems. And to make matters even more complicated, Novell also markets its own network, called NetWare/S-Net. We reviewed NetWare/S-Net here because it is the only system made up completely of Novell products.

**SETTING UP** Novell markets two dedicated servers with NetWare/S-Net, the 286A and the 68B. We tested NetWare/S-




*Novell's NetWare/S-Net system consists of (1) a special 68000 server with (2) a hard disk subsystem and (3) a network interface card for each workstation. The system uses (4) small-diameter twisted-pair wiring. We tested the system running under (5)* Advanced NetWare 68. *A separate dumb terminal is required to monitor the server and attaches to it with an RS-232C cable. Each station has a direct unshared communications link to the server that is polled regularly. You can connect up to 14 more stations to the server through an ARCnet system.*




Net with the 68B server. Server 286A is a brand-new system that combines an 80286 processor running at 8 MHz with a 30-megabyte hard disk and an optional tape backup. PC Labs did not test this system, but it is reasonable to expect its performance to be similar to that of the 8-MHz IBM PC AT used as a server for benchmark tests on other networks reviewed in this issue.

The Server 68B, which comes with a hard disk drive subsystem, is an updated version of the server that Novell has marketed for several years. The 68B is a rugged, conservatively designed machine. It is bigger than a PC AT and uses a Motorola 68000 processor. Inside, you'll find power-supply wiring that can deliver many amps of current. Transformers are mounted on the chassis rather than the circuit boards so that they won't rip off or bounce around. Large toggle switches snap solidly, and the high-volume, low-speed fans are made to last. We liked the 68B hardware.

Occasionally you might need to access a key switch on the server's front panel to reset the system, but otherwise you can hide the server and hard disk drive subsystem in a closet and forget them.

**INSTALLATION AND USE** NetWare/S-Net is fairly easy to install. The adapter cards came out of the box ready to insert into a PC, although you can set optional features with jumpers. To install the software for the workstations, you simply copy two programs from distribution disks onto working disks. Nor is much effort required to install *Advanced NetWare 68* on the 68B server. After you connect the workstations to the server, you type a command from one of the workstations to copy the system disks onto the server. The process takes 10 minutes.

We ran into one hitch when we tried to set up the system. The manual neglects to mention that you are required to provide a terminal that controls and monitors the activities of the server and connects to it through an RS-232C cable. This requirement can add several hundred dollars to the cost of the system. We used a PC running *Crosstalk* in this role, but, since the cable that Novell supplied us had connectors and wire arrangements that didn't work on the PC's serial port, we had to fabricate our own RS-232C cable.

NetWare/S-Net uses a star topology. A star arrangement takes more wire than a bus configuration but avoids the problems of media sharing. While hooking up many stations might cause contention for use of the hard disk and network processor, one

## FACT FILE

**NetWare/S-Net**
Novell Inc.
1170 N. Industrial Park Dr.
Orem, UT 84057
(801) 226-8202
**Workstation Requirements:** 256K RAM, DOS 3.1.
**Network Software:** *Advanced NetWare 68.*
**Prices:** Server 68B, $8,000; network interface boards, $250; disk subsystems: NDS2, $4,795; NDS4, $7,095.
**In Short:** NetWare/S-Net with server 68B is a good, solid network for heavy-duty transaction processing. The server is a rugged, conservatively designed machine. NetWare/S-Net is also quite a remarkably steady performer, showing little degradation from the lightest to the heaviest test loads. In addition, NetWare/S-Net is easy to install, with the exception that the documentation neglects to mention that you must attach a terminal to the server.

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bad adapter card or shorted cable cannot take the network down.

The connection between workstations and the server is made with small-diameter twisted-pair wiring using the RS-422 signaling scheme (which supersedes the RS-232C standard) running at 500K bits per second. Thus each workstation, in effect, has its own communications port on the server and polls this port on a regular basis.

You can hook up to 24 stations directly to the 68B server with up to 1,000 meters (or about 3,280 feet) of wire. For the 25th workstation, you must add another server. Alternatively, you can install Standard Microsystems Corp.'s ARCnet expansion card into the server, which allows it to accommodate 14 additional workstations. You also need a wiring hub and ARCnet network interface cards for the stations, which are strung together on a coaxial cable. Thirty-eight network stations would be a big load for any of the network configurations we tested. But the ARCnet connection is a nice way to add infrequent users to the system—say, for modem sharing—without tying up the dedicated communications ports.

**BENCHMARK-TEST RESULTS** Since the special *NetWare 68* software designed for the 68000 microprocessor contains all the menus and user features of *Advanced NetWare*, the functional ratings for this system are the same as those for systems using *Advanced NetWare*.

Although NetWare/S-Net on the 68B server was neither remarkably fast nor slow, it was remarkably consistent under a load. The benchmark-test performance time of the network cards and transmission media increased by about 60 percent from the lightest to the heaviest test loads. While some of the other systems started out faster than Novell's, their benchmark-test times increased by about 250 percent over the same increase in network load.

Similarly, in tests of practical and heavy workloads, NetWare/S-Net on the 68B server started out slower than some others but experienced little degradation no matter how hard it worked. If, as Novell claims, the slope of the degradation curve for throughput on the 68B server stays constant, this server can do some heavy transaction processing.

**COSTS** Novell markets NetWare/S-Net in several different ways. The 68B server alone has a list price of $8,000. A package with the network software, server, hard disk subsystem, plus four network interface cards and cables sells for $12,295. You can put together a less-expensive system using an AT and a bus network such as 3Com's or Gateway Communications' G/NET, but it would degrade more under heavy processing loads and lack the "industrial grade" engineering of NetWare/S-Net with the 68B.

If you have an application that requires heavy transaction processing, such as an on-line accounting or inventory system, you should seriously consider NetWare/S-Net with the 68B.

## Proteon Inc. ProNET-10

Proteon markets a wide range of networking alternatives, including network adapter cards for Convergent Technology's Unibus, Digital Equipment Corp.'s Multibus, and the IBM PC standard bus computers. These adapter cards can use twisted-pair, coaxial, or fiber-optic wiring as well as networking software from companies such as DEC *(DECnet)*, Novell (*NetWare*), and AT&T (UNIX). All in all, this is quite a multidimensional LAN product line. Proteon claims to have more than 700 installed LAN systems with over 11,000 nodes.

For IBM PC systems, Proteon markets a token-ring network called the ProNET-10. This network integrates a network interface card using the token-passing protocol, Novell's *Advanced NetWare/86* or *Advanced NetWare/286*, IBM's standard shielded twisted-pair cable, and a network hub. (Proteon has also announced a product called ProNET-4, which was not available for evaluation at the time of this review and which the company claims is completely compatible with IBM's token-ring network.)

**HARDWARE AND SOFTWARE** Proteon supplies an unmodified version of Novell's *Advanced NetWare/86* or *286* with the ProNET-10. You have to run the *NetWare* installation program yourself to generate a version of the software for the ProNET-10 boards. This takes about 15 minutes.

The ProNET-10 adapter card is a half-size card loaded with VLSI devices. The card's best feature is its simple installation in the PC: you just remove most of the slide-on jumpers (taking jumpers off is always easier than trying to get a large number of them on correctly). You do have to set a DIP switch on each board with a unique station address, but this is a simple job. You should, however, take care when assigning and recording the address for each card. This will save you the trouble of resetting a lot of switches should you decide to expand the network or link two networks in the future.

Each ProNET-10 network adapter card has a 15-pin connector that mates with IBM Type 6 shielded cable, which in turn connects to the network wiring hub. Type 6 cable consists of two twisted-pair wires inside a shielded mesh. This cable is fairly stiff and the plug and jack just push together, so be sure to carefully seat and screw down the connectors securely. Since Type 6 cable is just as expensive and difficult to install as RG-62 coaxial cable, the only advantage we could see to using it is that it fits nicely into the IBM wiring plan that is being installed by some major corporations. In most installations, the IBM Type 6 cable runs between the workstation and

PC MAGAZINE FACT FILE

**ProNET-10**
Proteon Inc.
4 Tech Circle
Natick, MA 01760
(617) 655-3340
**Workstation Requirements:** DOS 3.1.
**Network Software:** *Advanced NetWare/86; Advanced NetWare/286; DECnet;* UNIX.
**Prices:** Proteon network interface card, $799; eight-node wire center, $630; four-node wire center, $335.
**In Short:** The ProNET-10's adapter cards are easy to install. Small networks can be set up without problems, but networking more than 12 workstations is unduly complicated. Another plus: LEDs next to the connectors glow when an electrical connection is made, which helps in network troubleshooting.

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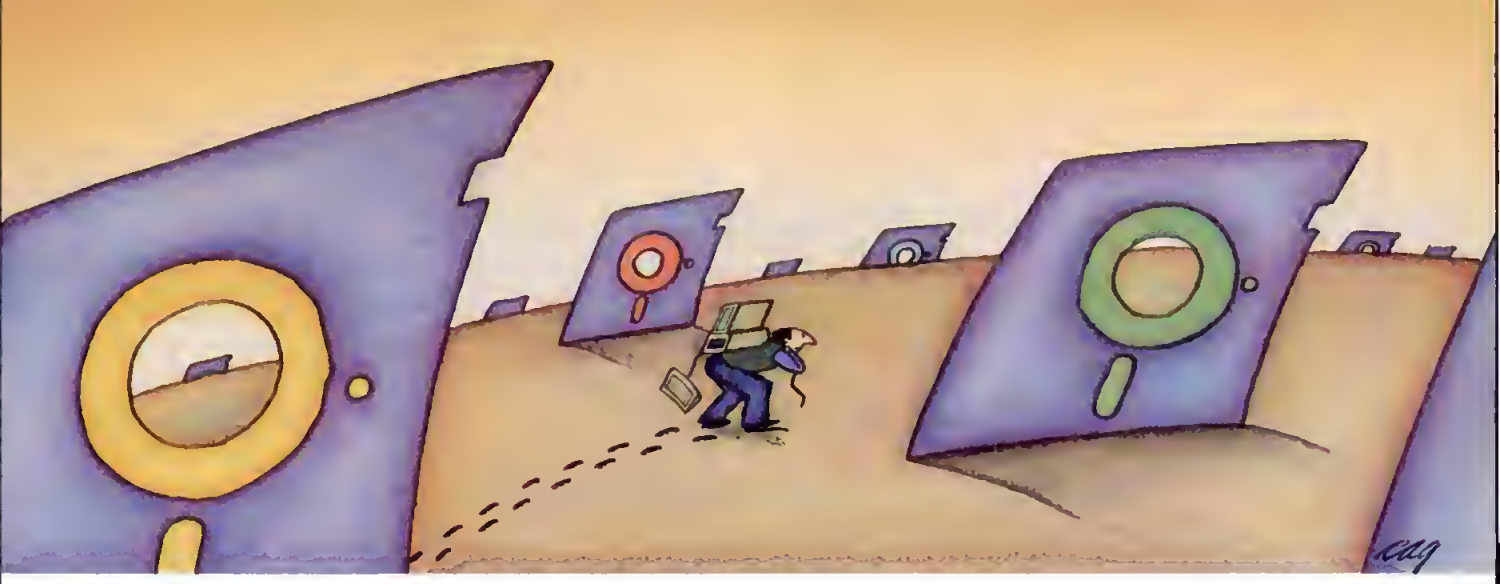

# PROBLEM: There's just no easy way to move from one software program to another.

# THE SOFTLOGIC SOLUTION: Software Carousel

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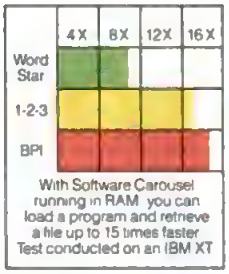

With Software Carousel running in RAM you can load a program and retrieve a file up to 15 times faster. Test conducted on an IBM XT

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This could be the best reason ever for owning an expanded memory card, like the Intel Above Board, AST RAMpage, or any card compatible with the L/I/M Extended Memory Standard.

Software Carousel puts programs into this "high-end" memory for temporary storage when they're not in use. And switches them back out when you want them. It's fast, efficient, and easy.

If you want, Software Carousel will even use your hard drive for swapping. Just allocate a portion for storage, and go to work.

### Sidekick, Superkey and Ready. All at the same time.

You know what happens if you try loading two or more RAM resident utilities at once. You get crashed keyboards, frozen screens, all kinds of interference between programs fighting for control.

With Software Carousel, you can have as many accessories and utilities on-tap as you want. Just load different ones in different Carousel partitions. Since they can't see each other, they can't fight.

### The easy way to maximize PC power.

With all this power, you might think Software Carousel is complicated and difficult to use. Not so. Set it up once, and it will remember forever. Better still, Carousel will look for the programs you use most often, and optimize them for the quickest access.

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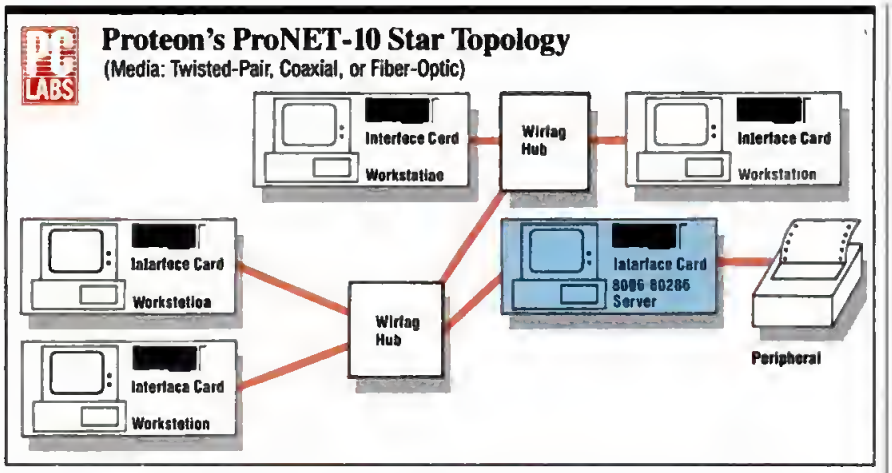


*Proteon's ProNET-10 system consists of (1) a network interface card for each PC, plus (2) a wiring center. Each card connects directly to the wiring center with (3) twisted-pair wiring. A fiber-optic version of the system is also available, and you can mix fiber-optic and coaxial within a network. Wiring centers are configured for 4, 8, and 12 workstations, and you can connect the centers in various ways to expand the network. We used an 80286 machine as a server running under (4)* Advanced Netware/286.

*ProNET-10's topology is a star-shaped ring. The physical cable connecting the workstations weaves back and forth from the stations to the wiring hub, which helps you to isolate and repair problems. But electrically, ProNET-10's media-sharing protocol is a circulating token that passes through an electrical ring of cable connecting the stations together.*

wiring hub while the larger IBM Type 1 is used between the hubs. You can also use IBM Type 2 cable—which combines the shielded pairs of Type 1 with several additional pairs of regular telephone wire—in a ProNET-10 installation to spread the cost of wiring among the telephone and LAN systems.

The ProNET-10's wiring hub is a flat box, about 3.5 inches by 9 inches by 1 inch, with multiple connectors. There are two types of wiring hubs, a nonpowered hub that doesn't need to be plugged into a wall socket and a powered one that does. The nonpowered hub accommodates a four-station network. Five or more stations require a powered hub.

The ideal wire hub for troubleshooting (we haven't seen it yet) would indicate both the electrical continuity of each leg of the network and whether data is moving on it. The ProNET-10 meets the first requirement. A bright LED glows next to the hub's connectors when there is an electrical connection between the wire center and the workstation. If the network goes down because of wiring problems, the LEDs will give you a clue as to the location of the problem. You can then manipulate a slide switch next to the LED to remove a workstation and its cabling from the network.

The ProNET-10 does not meet the second requirement for the ideal wire hub. The ProNET-10, unlike AT&T's StarLAN, has no lights on its hub that blink when the network is working. To determine whether removing a station has restored the rest of the ProNET-10 network, you have to go to one of the workstations or the server and experiment with some network operation.

**SIMPLE AND COMPLEX** Small ProNET-10 installations are relatively simple to install. If you need a network with up to 12 workstations, you just run a maximum of 56 feet of cable from any workstation to the hub.

Installations consisting of more than 12 stations or requiring more than 112 feet of cable between stations require a good deal of planning. You construct such networks chaining wiring hubs. You can plug two wiring hubs together, but installations with more than two hubs require the use of either a "nonclocking" or a "clocking" repeater (usually integrated into a third powered wiring hub).

Nonclocking repeaters regenerate packets, whereas clocking repeaters perform synchronization tasks. To link multiple hubs, you need a clocking repeater at either end of the network. A workstation can function as a clocking repeater as long as it is always on when the network is functioning.

Your choice of clocking or nonclocking repeaters will depend on the distance between stations and the configuration of the network. A complex formula, which takes into account the placement of the repeaters, determines the total amount of cable that you can use on the network.

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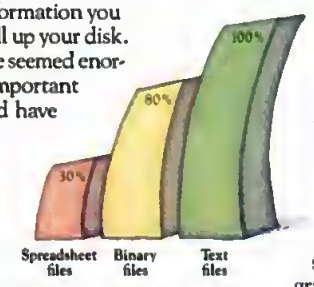


With Cubit, you'll get as much as 100% compression on data files, effectively doubling the storage capacity of all your magnetic media.

**What is Cubit?**

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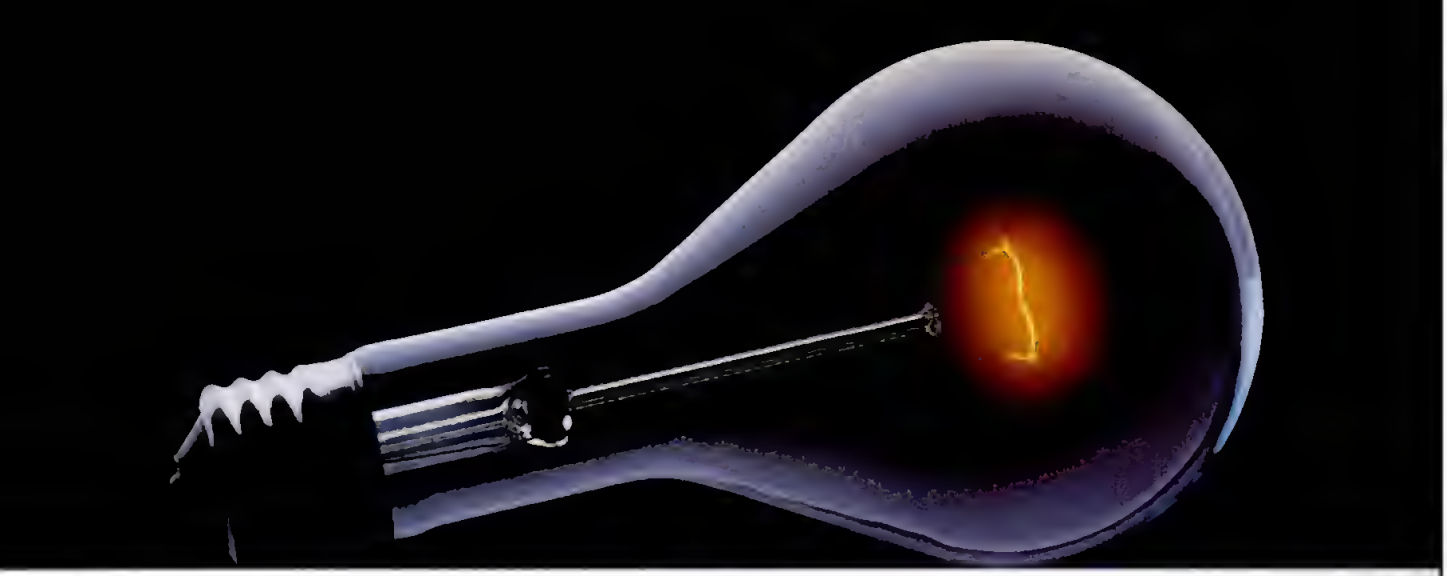

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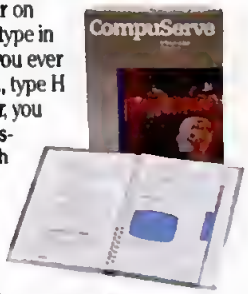


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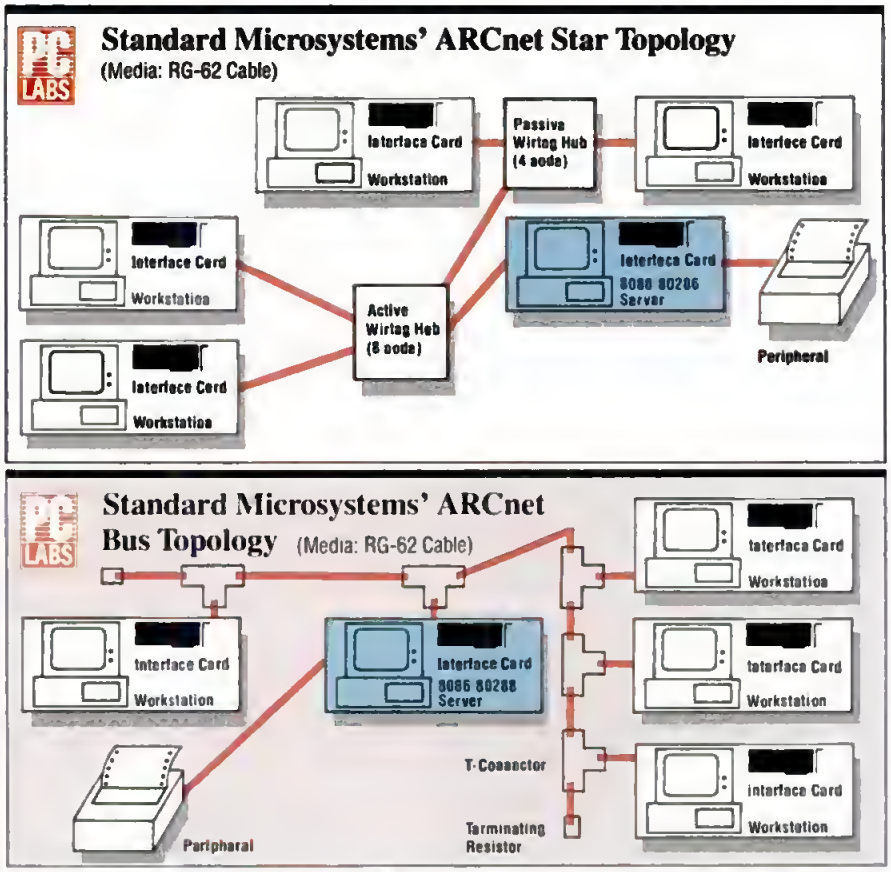
**OPERATION** ProNET-10 was neither the fastest nor the slowest of the networks we tested. The system ran well and quickly recovered when we tried to disrupt it by disconnecting cables. We tried to introduce electrical "noise" into the shielded twisted-pair cable by running it next to a sparking motor and through an electrical field but detected no effect on network performance.

**FLEXIBILITY** Proteon's greatest strength is its reliability and flexibility. Many of the company's other products are compatible with the ProNET-10, so you could, for example, use fiber-optic cable on your network. If you needed increased protection against disruption, Proteon offers systems that use redundant wiring. Proteon even offers software that will allow you to add the Department of Defense's Transmission Control Protocol/Internet Protocol (TCP/IP) which gives you network routing and recovery. Hooking up a small ProNET-10 network is fairly simple, but if you need to network a couple of dozen PC-type workstations, you'll find simpler solutions from other vendors.

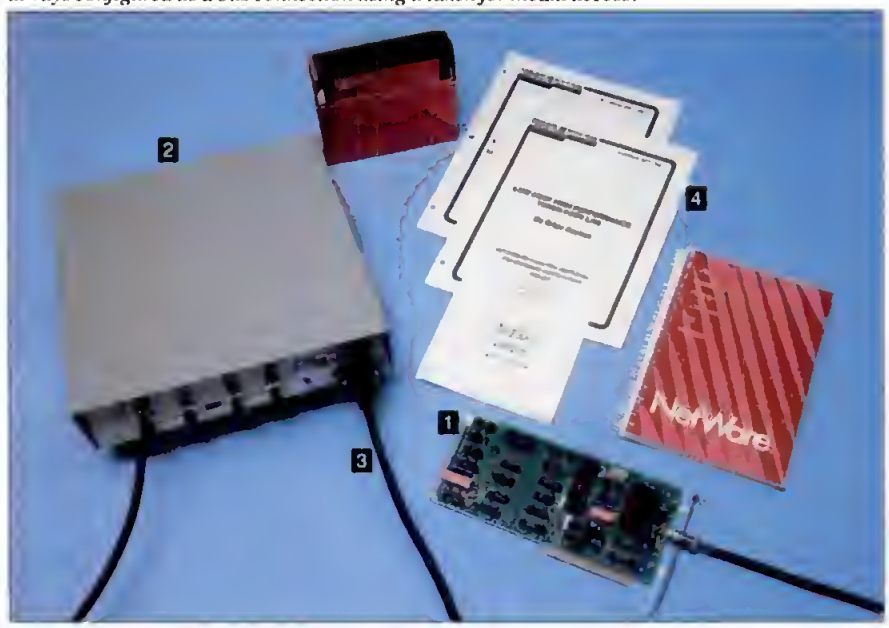
## Standard Microsystems Corp. ARCnet

When IBM Corp. released its token-ring LAN, the company (naturally) got a lot of publicity, even though LANs using tokens for media sharing with a physical star configuration have been available on mainframe, mini, and other systems for years. It was Datapoint Corp. that actually pioneered token-passing technology in the early 1970s with its Attached Resource Computer Network (ARCnet). Now Standard Microsystems Corp. has brought versions of the ARCnet (which remains a registered trademark of Datapoint) to S-100 and PC bus systems and added the ability to attach RS-232C devices. While the ARCnet and IBM token-ring systems are not compatible, the "media-sharing token" concept behind them is similar. Standard Microsystems' ARCnet for the PC combines an ARCnet token system with an excellent interface to Novell's *NetWare*.




*An ARCnet system includes (1) a network interface card for each station and (2) a four- or eight-node wiring hub. The cards connect directly to a hub through (3) an RG-62 cable. A new optional configuration from Standard Microsystems provides for direct connection between workstations in a bus arrangement. The bus uses T-connectors at each station and a terminating resistor at each end of the network. An 80286 acted as the server running under (4)* Advanced NetWare/286.

*Although ARCnet can be physically configured as either a bus or a star, electrically, it is always configured as a bus connection using a token for media access.*



**TOKEN NETWORKS** Many journals have debated the technical advantages of token networks. Typically, the argument in favor of token systems is that they are more predictable and reliable under heavy data loads than are CSMA (carrier sense multiple access) systems such as Ethernet. Token access systems pass a message (token) among stations that control which station can transmit. This method is more orderly than the CSMA contention system, under which stations simply transmit when they detect no activity on the network. If two stations on CSMA systems begin their transmissions simultaneously, their messages can collide, causing lost data.

In the ARCnet's scheme, as in other token networks, a master station passes a token to each station in turn. A station can transmit only when it has the token. Unlike other token networks, stations on the ARCnet token networks acknowledge the receipt of messages, ensuring successful communication. The ARCnet system also has special features that improve the addressing efficiency of the token-ring system while retaining its reliability, as well as sophisticated server-to-server protocols that help in linking networks.

**WIRING** The Standard Microsystems version of the ARCnet simplifies the process of installing and troubleshooting the wiring by using a hub wiring system. In a hub system, each cable from a network station attaches to a central wiring-connection point. If a cable is severed or shorted, it can be easily identified and disconnected from the central point. This connection scheme uses more cable than a bus that runs from station to station, but even so, the ability to isolate bad cable legs is invaluable.

Although the ARCnet's physical configuration looks like that of IBM's token-ring LAN, the electrical configurations of the two systems are, in fact, very different. The IBM system is an electrical ring; its token must flow through every workstation on the ring to complete the circuit. A severed or shorted cable or a bad adapter card will crash the entire network. In contrast, the ARCnet's electrical configuration is a bus. Its token travels down the bus, but because of the central cable hub, a poor connection in a workstation cable or even a failed adapter card will not disrupt the entire network.

The ARCnet cable hubs can be either passive (unpowered) or active (powered). You can connect a workstation to a passive hub using up to 100 feet of RG-62 coaxial cable. Active hubs regenerate the packet to ensure high-quality transmission over long cables and can drive data over 2,000 feet of cable to a workstation or to another active hub. It is also possible to link active hubs to construct a network with stations up to as far as 4 miles apart. Properly configured, a single ARCnet network could cover over 11 square miles. Almost all other LAN systems would need expensive internetworked servers or special repeaters to cover this much area.

In some installations, it may be impractical to run all of the cables to a central point. Therefore, Standard Microsystems recently released an entirely new network interface card that does not require a hub. The new Model PC200 ARCnet cards can connect up to eight nodes on a maximum of 1,000 feet of cable. You can also connect eight-node network segments through an active repeater or convert the entire system over to a physical star configuration without changing any of the network interface cards.

PC MAGAZINE FACT FILE

**ARCnet**
Standard Microsystems Corp.
35 Marcus Blvd.
Hauppauge, NY 11788
(516) 273-3100
**Workstation Requirements:** DOS 3.1.
**Network Software:** *Advanced NetWare/286; Vianetix Vianet.*
**Prices:** ARCnet-PC100 interface board, $545; ARCnet-PC200 interface board, $595; ARCnet-PC300 interface board, $1,295; Active Link (fiber-optic board), $375; Active Link-OPT (two-port active hub for PC200), $1,295; four-port passive hub (for use with PC300), $100; eight-port active hub, $885.
**In Short:** ARCnet performed the best of the networks tested that used an AT as a server, although under increasing network load, ARCnet's throughput rate declines slowly. In addition, ARCnet is a flexible system that lets you start small, but adding wiring hubs gives you room for great expansion.

CIRCLE 695 ON READER SERVICE CARD

**TOP-NOTCH PERFORMER** In theory, ARCnet's message acknowledgments and traveling packets are supposed to add overhead; nonetheless, the system performed very well on the PC Labs speed and workload tests, and it performed the best of all the networks tested using an IBM PC AT as a server. According to various technical publications, LANs using the ARCnet protocol prevent one station from hogging the network, thereby allowing fair access to all stations. Our benchmark tests showed that the ARCnet is fast under conditions of no load and that under a heavy load, the throughput degrades gracefully, with no sharp performance drops. We were unable to test the ARCnet on the Novell 68B server, but Novell now offers this combination and it should perform very well.

**PIECES OF THE LAN** Standard Microsystems manufactures its own 9026 LSI CMOS controller chips for its interface cards. The speed and compatibility of these chips are responsible for the LAN's high performance and make installing the LAN simple. Additional support chips interface with the PC's data bus.

The ARCnet PC100 network interface cards come ready to install and have almost no slide jumpers. Some vendors' cards have as many as 40 slide jumpers, all of which must be set correctly for the system to work. All you need to know to install the PC100 cards in your PC is contained in a two-page illustrated guide that describes the proper settings of the rocker switches.

We had no problems using the cards with any PC. They will fit into any slot on an AT but won't take advantage of the AT's 16-bit bus connections.

The ARCnet adapter cards normally use coaxial cable, but versions of the cards designed to interface with fiber-optic cables are also available. One network cable runs from each ARCnet station to the hub—some bus systems require two cables plus T-connectors—cutting down on the wiring mess at the workstations. And you are not required to terminate or switch out the ports on the active hub when they aren't in use. In addition, no special grounding actions are needed for the cables, as they are in some systems.

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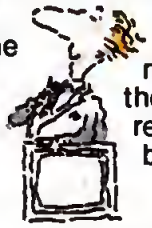

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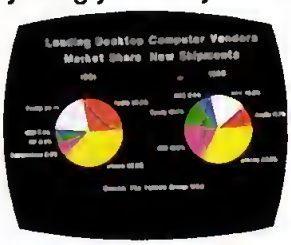


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You can connect non-PC-compatible computers or terminals with RS-232C ports to the network through a product called the ARCnet-Link. This is a separately powered adapter box containing both an RS-232C port and a network connection, which also does the important job of buffering the data going in and out of the slower RS-232C port. We didn't test the ARCnet-Link.

The only improvement I can suggest to the Standard Microsystems hardware would be to add an indicator on the active hub that shows when a workstation has a solid electrical connection. The front of the cabinet containing the hub does have flashing LEDs showing network activity, but some indication of workstation status is useful when you are crouched in a wiring closet trying to figure out why something won't work.

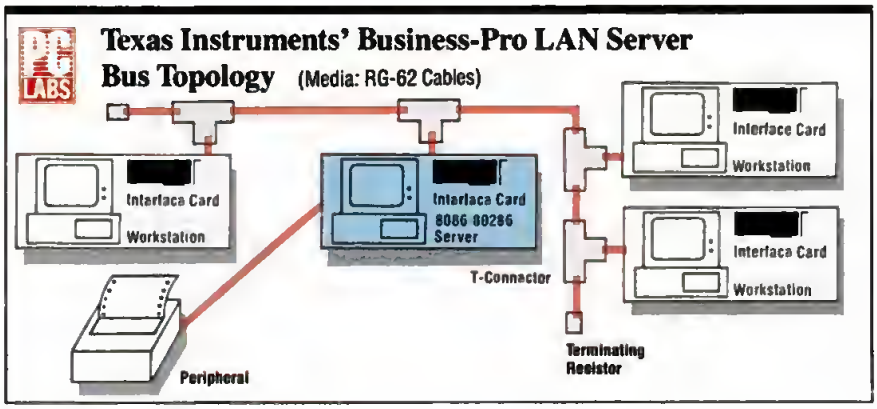
Standard Microsystems supplies *Advanced Netware/286* with its hardware. Standard Microsystems ships Novell's product in the original shrink-wrap with no changes or additions. However, the Standard Microsystems custom processor seems to take to *NetWare* very well.

**COSTS** The Standard Microsystems Model PC200 network interface board can be connected either in a physical star or bus configuration and sells for $595. The Model PC100 board, which must be used with an active hub, is priced at $545. The active hub, which can connect up to eight workstations, carries a price of $885.

The ARCnet system offers a proven technology that can move a lot of data over a wide area. The flexibility of the newest Standard Microsystems interface cards allows you to start out with a small system at a moderate cost and leaves room for great expansion.

## Texas Instruments Business-Pro LAN Server

Texas Instruments has its own line of computers that are PC compatible—except that they use a modified version of MS-DOS and special graphics cards. TI computers run in two modes: TI mode and IBM PC emulation mode. You must run the TI




*The Texas Instruments network uses (1) 3Com's EtherLink network interface cards with (2) T-connectors and (3) terminating resistors. (4) RG-62 cables run to and from each network station. (5) The TI Business-Pro acts as a server for either TI or IBM standard workstations. The server runs under (6)* Advanced NetWare/E-T1. *This system uses the CSMA listen-before-transmit media-sharing protocol on a bus-wiring configuration.*

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computer in TI mode to use the TI graphics software. In order for the TI computer to run IBM software or to run on a LAN designed for IBM PCs, you are obliged to switch to the IBM emulation mode. To change modes, you must use a DOS command, which can be an inconvenience when you need to use both the TI graphics software and a LAN.

To help its users, therefore, Texas Instruments designed its own LAN, called the Business-Pro LAN Server, specifically for organizations that have invested in TI and IBM personal computers. Its interfaces allow both the TI and IBM PCs to operate normally on the LAN.

**TI PLUS** The TI network consists of pieces from several different vendors: its own TI Business-Pro personal computer acting as a file server, networking cards and cables from 3Com, and a version of Novell's *NetWare* called *Advanced Netware/E-TI*.

The attractively styled Business-Pro is the top of the TI personal computer line. (For a review, see "Power Computing: Alternatives to the IBM PC AT," *PC Magazine*, Volume 5 Number 8.) With a smaller footprint than an AT, the Business-Pro LAN Server can sit next to your desk on its own pedestal mount. It can carry heavy loads of hard disk, tape backup, and IBM PC AT add-on peripherals. In addition, you can augment its 80286 processor with an 80287 math coprocessor and large amounts of internal memory.

TI uses the 3Com EtherLink network interface card, which gives you the Ethernet standard electrical connections and media-sharing protocols (CSMA/CD). The EtherLink card for PC systems is a half-size circuit board containing a VLSI Ethernet Data Link Controller Chip and the network transceiver. The EtherLink Plus card is available for IBM PC AT–type systems that use the faster 16-bit address bus of the AT.

TI has supplied an enhanced version of Novell's *NetWare* with its system. The software comes with boot disks for the workstations (generic versions of *NetWare* require you to generate them yourself using the GENOS [generate operating system] command). If you accept the default values for the buffers and ports in the server and don't do any special disk drive tests, you can have the network software loaded and ready to go in 15 minutes. TI also customizes *NetWare* to allow TI and PC workstations operating under DOS 2.1 or 3.1 to enter the network.

All of these network pieces hook together into a bus network. Each workstation has two cables attached to the interface connector through a T-connector. The overall length of the network is limited to 1,000 feet of cable, and you must terminate the ends of the cables with special resistors.

**PUTTING IT TOGETHER** TI's documentation for its network is very comprehensive. I learned more about the technical operation of Ethernet there than I did from textbooks written on the subject. However, the documentation is also exceptionally complicated, and we had difficulty finding the information we needed. TI reprinted most of the Novell documentation and added improved illustrations and descriptions in several areas. Customer support is available from both Novell and TI, but our experience shows that you might still have problems getting answers to questions you may have about this hybrid network.

Setting up the Business-Pro as a LAN server was fairly straightforward. The TI manual clearly documents the process of preparing the server and installing the interface cards. Installing software on the server was also fairly easy: you just feed disks into the floppy disk drive in response to prompts on the screen.

However, we hit a snag when we tried to install the Business-Pro/*NetWare* workstation software on some of the PCs. The software ran fine on the IBM PC, Zenith, and ITT machines, but it would not run on a new IBM PC AT operating at 8 MHz. When we tried to get a patch to allow the program to run at 8 MHz, we ran into a glitch in TI's technical support. Neither TI nor Novell could help us. Since the same 3Com card runs in the 8-MHz AT under other versions of *NetWare*, as well as under the 3Com networking software, we conclude the problem was caused by customization of the software.

Installing the 3Com cards and cable was also difficult, taking many hours and whispered incantations. Although 3Com claims there is a standard shipping configuration for the networking cards, we received several variations. This is unfortunate because you must set over 40 jumpers on each card.

We finally used a three-man team to set the jumpers: one read the manual, one moved jumpers, and one checked every move. To make matters worse, we had a hard time finding the description of the procedure in the documentation, because the manual includes descriptions of several models of EtherLink cards using several different operating systems.

Commonly, networks neglect to help you diagnose problems. The Business-Pro LAN Server was no exception. When we set up the system, the workstation closest to the server signed on, but other machines farther down the line did not.

We spent a lot of time changing jumpers and swapping cards and trying to reboot the system—until finally we swapped cables. It turned out that we had had a bad cable connector on a PC three machines down the bus from the server. We were very lucky. If the bad cable had been on the workstation farthest from the server, nothing would have worked.

PC MAGAZINE FACT FILE

**Business-Pro LAN Server**
Texas Instruments
Data Systems Group
P.O. Box 809063
Dallas, TX 75380-9063
(800) 527-3500
**Workstation Requirements:** DOS 3.1, 256K RAM, one floppy disk drive.
**Network Software:** *Advanced NetWare/E-TI*.
**Prices:** TI Business-Pro computer, $5,795; 3Com EtherLink cards, $750; *Advanced NetWare/E-TI*, $1,595; 23-foot 3Com cable, $30; two terminating resistors, $40.
**In Short:** The Business-Pro LAN Server networks Texas Instruments and IBM PCs, allowing each to operate in its native mode on the LAN. Although this LAN is slower than other systems, the server can carry heavy loads of hard disk, tape backup, and add-on peripherals. Although TI provides excellent documentation, installation is complicated because you must set over 40 jumpers on each card.

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*"TurboTax takes the prize for most forms our favorites for this review were TurboTax —InfoWorld, March 1986*

*"Flexible, Affordable and Complete —PC Magazine April 1985 "It makes doing your taxes almost fun "—Bill Alvarez, PC Magazine, April 1985.*

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## ■ LANs UNDER NETWARE

**PERFORMANCE** We ran the Business-Pro LAN Server according to the TI instructions, using TI's version of MS-DOS. We kept the machine in the turbo mode, which is supposed to improve performance over the 6-MHz AT–emulation mode. Because of the problem with the AT workstation software, we substituted a PC for the AT we normally used as a workstation for benchmark-testing of the TI system. Theoretically, this should have improved the network's performance on the timing tests, because the faster AT workstation usually puts a heavier load on the network, slowing the performance of the XT that runs the standard timed test.

With the exception of the 8-MHz workstation limitation, the TI version of *NetWare* ran well on the Business-Pro LAN Server. Our benchmark tests showed that despite its power, the Business-Pro/3Com/*NetWare* combination slowed more under heavy loads than other networks that used the AT as a server. This slowdown could have been caused by the fact that the version of *NetWare* provided for our tests was not *Advanced NetWare/286*, which is designed to allow the 80286 processor to operate efficiently in its "protected" mode. However, by the time this article appears, the manufacturer claims that it will supply the updated *NetWare*.

**COSTS** The Business-Pro LAN Server with 512K bytes of RAM, tape backup, color monitor, 40-megabyte hard disk drive, 1.2-megabyte floppy disk drive, and EtherLink card sells for $12,200. This price includes Novell's *NetWare*. Each EtherLink card costs $750, and a 23-foot cable with connectors is $30. A kit of two terminating resistors is $40.

**FLEXIBILITY** If your organization has TI PCs, TI has a network solution that will meet your needs. You can continue to run TI's programs and still integrate IBM PCs into the network. In addition, the Business-Pro LAN Server offers easy archiving and large storage capacities that your organization might need. However, if you intend to use the most modern high-speed AT and AT-alternative machines on the network, you should be sure that TI's workstation software has been modified to support them. PC

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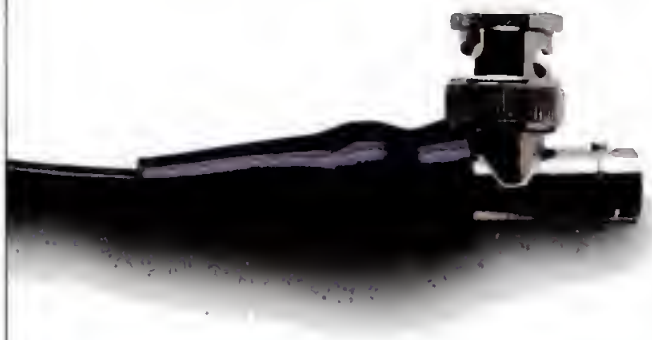

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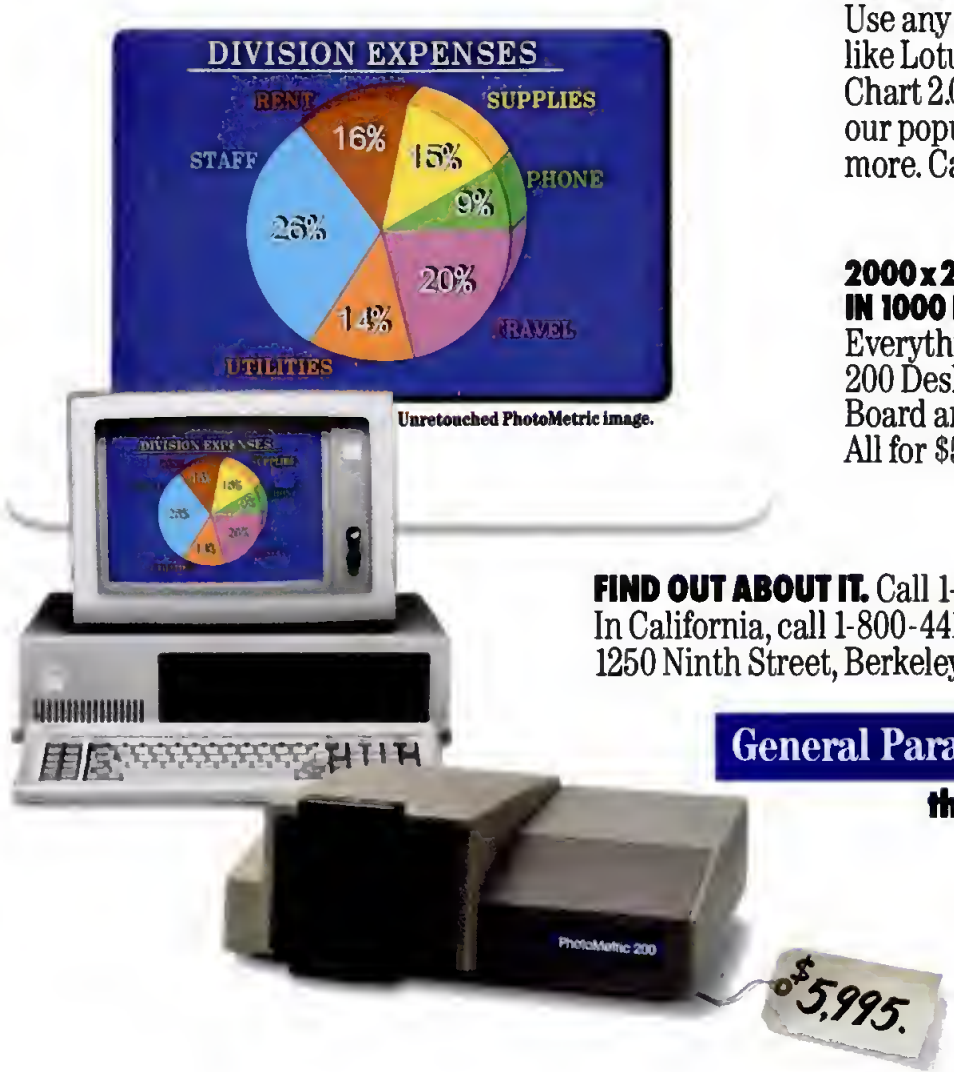


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CIRCLE 178 ON READER SERVICE CARD

# A Networking Tool Kit

**While testing LANs in PC Labs, we learned some valuable lessons—the hard way. This is your chance to benefit from our experience: the tips included here should ease the strain of network installation and administration.**

COVER STORY
FRANK J. DERFLER, JR.,
AND ED HALBERT

Engineers are the master planners of local area networks: they design, install, and configure a LAN system to meet your individual needs. Once it's there, however, it's the network administrator's responsibility to keep the system up and running efficiently. The job includes such tasks as maintaining the system's files, controlling user access, and managing resource sharing. Keeping track of all the separate elements involved looms as no small task—especially if the job happens to be yours.

During the course of our own testing procedures (see "Making Connections: LANs Under NetWare" in this issue), we developed some procedures to make installation and management easier. Here are some tips about batch jobs, editing techniques, and other methods that will help you to feel your way around the "LAN mines" of networking.

**INSTALLATION** Almost all networking software packages require some sort of installation procedure. (A few network servers, such as those from Tallgrass, come with the software installed.) Not even experienced users can always predict whether installation will take a few minutes or several hours.

The two basic types of installation tools are .EXE programs and .BAT script files. These files direct the installation, construct the basic starter system, create directories, and copy files from the disk to your server and perhaps to the user workstation disks as well.

# There's nothing standard about this corporate standard.

The standard is MultiMate Advantage.™

The word processing software program found on the "approved" list of most major companies.

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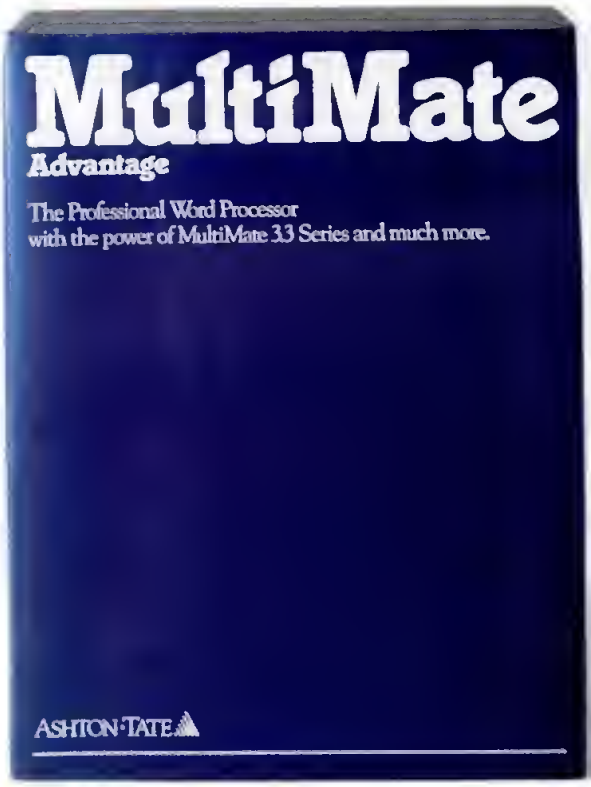
It's the first word processing program good enough to live up to everyone's standards.

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CIRCLE 210 ON READER SERVICE CARD

Many installation procedures are easy to understand and require you to do nothing more than hold your breath as you watch the hard disk light come on and stay on for a long time. At this point, our best—and most elementary—advice is always to make backups whenever possible. Also, read the manuals—especially the photocopied pages stapled together and folded up in the front of the manual. They contain many of the company's installation tips as well as any changes to the manual.

No problems are more frustrating than those which abort the installation process. Getting messages such as "Abend invalid parameter" or "File not found installation terminated" on your screen can be the start of a bad day. During the PC Labs LAN evaluation process, we started many bad days. However, most of our installation problems came from hardware, not software, with the major hardware problem being improperly configured boards.

If your installation program is on a floppy disk that must be booted and is not DOS readable, there is only one thing to do: make sure that you have met all of the manual's requirements. However, you have a better opportunity to correct or modify problems at start-up if the program is a batch file. When you get a nonexplanatory installation aborted message, you can do some detective work by making two quick changes to the file.

It's simple to remove the ECHO OFF statement that usually precedes any batch procedure. Then the screen will display the job stream, and you can see the action that gave you those wonderful "file not found" or "file creation error" messages. The problem will be easy to locate: it will be the command just before the error message.

Many batch job writers put a > NUL: at the end of the network program command line. This is a redirection technique that sends the output from the program to a place in the computer where it is neither saved nor displayed—more commonly known as the "bit bucket." This technique keeps the screen clear of any extraneous messages. To make a change, simply replace the > NUL: with blanks or > PRN:. Redirecting the output to the printer creates a log of any messages that the program might report to you. This log also serves as a handy reference when you're talking to technical support staff about a problem.

**TUNING AND PRUNING** Once installation is finished, you'll probably have to configure, or "fine tune," the network to your particular needs. On the simplest level, this refers to increasing or decreasing the buffers or printer spools. Expect to use the network for a while before you learn the optimum settings. Changing them usually involves editing CONFIG.SYS, AUTOEXEC.BAT, and any start-up batch files, and such changes are generally made to the parameters of start-up networking programs. Hence, using thoughtfully planned batch files, the network administrator can customize a network for specific needs.

■ Many batch job writers put a >NUL: at the end of the network program command line. Simply replace it with >PRN: to create a log of messages the program reports.

When setting up batch files, the single most important procedure is to document them. Sounds silly, doesn't it? After all, batch files are easy to read and their functions are evident. That might be true, but what isn't always clear or remembered is why the functions are performed in the order or manner called for in the batch file.

When the disks in the PC LAN Lab settled to rest after a long week of testing and evaluation, we gathered all the batch jobs we had created and found that they comprised pretty basic tools for network management. We hope you will find them as valuable as we have.

**HUNTKILL.BAT** Doing disk file backups is critical, but it also can be confusing. Sometimes copy actions just don't work the way you want them to. If you start to copy files from a floppy disk to a directory on the hard disk and suddenly realize that this is not what you want to do, HUNTKILL.BAT (Figure 1) can help. This routine will delete files on the target disk only if they exist on the source disk. You do not have to look at all of the directories of each disk to determine which files you accidentally copied. The syntax is:

```
HUNTKILL source_filespec target_filespec
```

**SAVEPATH.BAT** Once you start a software package on your server, you may wish to temporarily alter the path that was created by the start-up job stream. Many networks set up a PATH statement in the AUTOEXEC.BAT file. But before altering the path, you should save the current path status for later use. The SAVEPATH.BAT routine shown in Figure 2 uses redirection and takes advantage of the fact that the PATH statement by itself will display the current path. If you redirect the output from the PATH command to a batch file, simply executing that file

```
ECHO OFF
FOR %%1 IN (%1*.*) DO DEL %2%%1
```

**Figure 1:** *The HUNTKILL.BAT routine will delete files on a target disk only if the files exist on the source disk. The syntax is HUNTKILL* source_filespec target_filespec.

```
ECHO OFF
PATH > OLDPATH.BAT
ECHO Current PATH status saved in a file
     named OLDPATH.BAT. > CON:
```

**Figure 2:** *SAVEPATH.BAT provides a safety net by saving a PATH statement while you try out various alternatives. The batch file will reinstate the original path when run.*

# Once upon a midday dreary,

*While I pondered, weak and teary,*
*How to find some missing theory,*
*For my micro to restore;*

✓ **denotes IBM-AT compatibility.**
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We only carry the latest versions of products. Version numbers in our ads are current at press time.

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✓dBase III Plus LANpak ..... call
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✓Personal Investor 1.0 ..... 129.
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★ ✓Turbo Graphix Toolbox 1.0 ..... 41.
★ ✓Turbo Editor Toolbox 1.0 ..... 41.
★ ✓Turbo Newpak *(Gameworks and Editor)* ... 52.
★ ✓Turbo Lightning 1.0 ..... 59.
★ ✓Word Wizard 1.1 ..... 41.
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★ ✓Turbo Prolog 1.0 ..... 59.
★ ✓Turbo Family Jumbo Pack ..... 187.
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★ ✓Traveling Sidekick 1.0 ..... 43.
★ ✓Traveling Sidekick w/Sidekick ..... 73.
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★ ✓Superkey/Sidekick Package ..... 69.
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**Breakthrough** *(not copy-protected)*
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### PC Connection Software Special
*through December 31, 1986*

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★ ✓Cornerstone 5.2 ..... 59.
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★ ✓Volkswriter 3 1.0 ..... 147.
★ ✓Volkswriter Scientific 1.0 ..... 289.
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★ ✓Ready 1.0 ..... 49.
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★ ✓Jim Fixx's Running Program ..... 21.
★ ✓Managing Your Money 3.0 ..... 107.
★ ✓Menaging the Market 1.0 ..... 77.
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✓Easy *(with 67,000 word speller)* ..... 59.
✓Easy Extra *(Easy with Easy Mail)* ..... 89.
★ ✓WordStar 3.31 ..... 179.
✓WordStar Propak 3.31 ..... 259.
✓WordStar 2000 Plus Release 2 ..... 285.
**Microrim** *(not copy-protected)*
✓Clout 2.0 ..... 135.
✓R:base 5000 1.01 ..... call
✓R:base 5000 1.01 *(runtime version)* ..... 237.
✓R:base System V 1.0 ..... 359.
**Microsoft** *(not copy-protected)*
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★ ✓Multiplen 2.01 ..... 119.
✓Microsoft Access 1.01 ..... 163.
✓Microsoft Word 3.1 ..... 279.
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★ ✓Microsoft Chart 2.0 ..... 197.
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★ ✓Quick Basic 2.0 ..... 59.
★ ✓Macro Assembler 4.0 ..... 97.
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PC CONNECTION®

# While I nodded, nearly napping,

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*Mingling with my PC's zapping,*
*Rapping at my office door.*

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**Sierra On-Line**

★ Smart Money 1.0 ..... 49.

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| Compaq | Typing Tutor | |
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**Simon & Schuster** *(not copy-protected)*

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## EDUCATIONAL

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★ Easy as ABC ..... 24.

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★ Kids Stuff *(eges 3 to 8)*. . . . . 27.

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★ Word Spinner *(eges 6-10)* ..... 23.

★ Moptown Parade *(ages 6-10)*. . . . . 26.

★ Reader Rebbit *(eges 5 to 7)*. . . . . 26.

★ Rocky's Boots *(ages 9 and up)* ..... 32.

★ Robot Odyssey *(eges 12 and up)*. . . . . 32.

**True Basic, Inc.** *(not copy-protected)*

★ Calculus *(reqs. True Basic package)*. . . . . 32.

★ PreCalculus *(reqs. True Basic package)* . . . . 32.

★ Probability *(reqs. True Basic package)* . . . . . 32.

★ Trigonometry *(reqs. True Basic package)*. . . . 32.

★ Algebra *(reqs. True Basic package)* ..... 32.

## RECREATIONAL

All recreational programs listed are copy-protected except where noted.

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*Realistic financial simulations.*

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★ Baron ..... 36.

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★ Squire ..... 38.

★ Tycoon ..... 36.

For the IBM-PC (XT & AT) *Exclusively.*

# PC CONNECTION®

# Could it be some help from nearby,

*Entering my frantic sphere by*
*Shoving right before my clear eye,*
*Basics of computer lore?*

**Broderbund** *(reqs. graphics brd.)*
- ★Lode Runner ... $22.
- ★Championship Lode Runner ... 22.

★↙Ancient Art of War ... 27.
★↙Breakers *(text game)* ... 29.
★↙Toy Shop ... 39.

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- ★Murder by the Dozen ... 17.

**Electronic Arts** *(reqs. graphics brd.)*
- ★Pinball Construction Set ... 17.
- ★Music Construction Set ... 17.
- ★Dr J/Larry Bird One-on-One ... 17.

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*Great arcade style games*
★↙Big Top ... 27.
★↙Cosmic Crusader ... 27.
★↙Master Miner ... 27.
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**Hayden Software** *(reqs. graphics brd.)*
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*Difficulty levels shown in italics*
↙*STANDARD*
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★Cutthroat ★Wishbringer ★Zork I
★Ballyhoo Fooblitzky
★Hitchhiker's Guide ... *each* 24.
★↙*ADVANCED*
Zork II Zork III Sorcerer
A Mind Forever Voyeging ... *each* 27.
★↙*EXPERT*
Spellbreaker ... 29.
*Invisiclues (hint booklets). Specify game* ... 6.

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★↙Microleague Baseball ... 25.

**Microprose** *(reqs. graphics brd.)*
★↙F-15 Srike Eagle ... 22.
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★↙Hellcat Ace ... 22.
★↙Spitfire Ace ... 22.
★↙Solo Flight ... 22.

**Microsoft** *(reqs. graphics brd.)*
★↙Flight Simulator 2.12 ... 32.

**Mindscape** *(reqs. graphics brd.)*
↙Balance of Power *(avoid nuclear war)* ... 30.

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★↙Golf's Best *(Pinehurst)* ... 19.
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## PC Connection Hardware Special

*through December 31, 1986*

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- No Tools Required for assembly, precision snap-fit components

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**PCSoftware** *(not copy-protected)*
★↙Championship Blackjack ... 25.
★↙Armchair Quarterback ... 25.
★↙Chess 2001 ... 25.
★↙Championship Backgammon ... 26.

**Sierra On-Line** *(reqs. graphics brd.)*
★↙Championship Boxing ... 24.
★↙Black Cauldron ... 25.
★↙Space Quest ... 32.
★↙King's Quest ... 33.
★↙King's Quest II ... 33.
★↙King's Quest III ... 32.

**Simon & Schuster**
★↙Star Trek/Kobayashi ... 27.

**Sir-Tech**
★Wizardry ... 36.

**Spectrum Holobyte** *(reqs. graphics brd.)*
★↙Orbiter *(Shuttle simulation)* ... 27.
★↙GATO ... 27.
★↙Tellstar 2 *(search the skies)* ... 45.

**Sublogic** *(reqs. graphics brd.)*
★↙Night Mission Pinball ... 29.
★↙Jet ... 33.
★↙Scenery *(airport)* disks for Jet ... *each* 15.
★↙Japan Scenery Disk ... 15.
★↙Star Scenery Disk—San Francisco ... $15.
★↙Package of all 6 Western Airports ... 69.

**XOR** *(not copy-protected)*
↙NFL Challenge *(be the coach)* ... 79.

## HARDWARE

Manufacturer's minimum limited warranty period is listed after each company name. Some products in their line may heve longer warranty periods.

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Second serial, parallel or game port ... 35.
SixPakPlus 64k C/S/P *includes Sidekick vers. 1.5 not copy-protected & DESQView* ... 169.
SixPakPlus 384k *(fully populated)* ... 209.
SixPakPremium 256k C/S/P *upgrades to 1 Meg on board, 2 Meg w/ opt. piggyback board; EEMS compatible, includes DESQView* ... 319.
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will set the path back to what it was. You could also use this technique to duplicate the same path for another system or with the DOS SET command to save the environmental parameters.

**LOGON.BAT** While most network systems have some sort of log-on program and a set of welcome messages, you might prefer to customize log-on procedures.

In the example shown in Figure 3, the environmental variable USER sets the user's log-on name. This variable is then accessible by any other batch job that refers to "%USER%". The network log-on command follows with its own parameters. If the network log-on command requires more than one parameter—such as a password—you must also pass that parameter to the log-on command. You may or may not want to put the > NUL: after the log-on command. Use this technique if you don't really want a welcome message. Leaving > NUL: off will let you know of any errors during the log-on message.

Figure 3 also shows the use of a network command called LINK. This command is found in 3Com's Ethernet, AT&T's StarLAN, and similar systems. System administrators in Novell networks might substitute the MAP command. In general, such commands link or map certain subdirectories on the server's hard disk to a workstation drive letter. In this case, we linked a named subdirectory on the server's disk as a D: drive.

Then the program goes to the user's home directory by using the USER environmental variable. The next three lines are meant to be used with another utility, called WHOSON, which is described later. It copies any arbitrary file in the WHO directory to a file called by whatever the user's log-on name is. This stratagem serves as a flag to display the names of any active users on the network if such a utility is not already provided. The log-on times are recorded in a journal file for accounting purposes. The syntax for the example shown in Figure 3 is:

```
LOGIN myname password
```

Using Figure 3 as a model, you can change the syntax of the LOGON and LINK commands to match the command names used in different networks.

■ Some networking software doesn't include a function that tells you who is using the system. With WHOSON.BAT, you can see who is actively logged on.

```
ECHO OFF
CLS
SET USER=%1
(logon) \\servername\%1 %2 >          (example only)
(link) d: \\servername\sharename      (example only)
d:
CD \%USER%
COPY d:\WHO\X d:\WHO\%1.USR > NUL:
ECHO User: %1 signed on > d:\WHO\USERLOG.FIL
TIME < d:\WHO\CR > d:\WHO\USERLOG.FIL
```

**Figure 3:** *LOGON.BAT creates a customized log-on procedure. The syntax is* LOGON myname password.

```
ECHO OFF
CLS
(link) d: \\servername\sharename          (example only)
DEL d:\WHO\%USER%.USR
ECHO User: %USER% signed off > d:\WHO\USERLOG.FIL
TIME < d:\WHO\CR > d:\WHO\USERLOG.FIL
(unlink) d:         (example only)
A:
(logout)    (example only)
```

**Figure 4:** *LOGOUT.BAT is the complementary command to the log-on procedure shown in Figure 3. The syntax is LOGOUT.*

```
ECHO OFF
CLS
(link) d: \\servername\sharename    (example only)
d:
ECHO Users currently logged on: > con:
DIR \WHO\*.USR
(unlink) d:                (example only)
```

**Figure 5:** *WHOSON.BAT, when used together with LOGON.BAT and LOGOUT.BAT, will give you a status report showing which users are currently logged on to the network.*

**LOGOUT.BAT** Use the LOGOUT.BAT routine shown in Figure 4 in conjunction with the LOGON command. Essentially, it performs the reverse of its sister batch file, LOGON.BAT. The reason that we create a link at the beginning is to make absolutely sure that we can go back to the *Y*: drive later to update the USERLOG.FIL and the WHO directory. Then we unlink and return to the A: or starting drive and use the network log-out command. The syntax is LOGOUT.

**WHOSON.BAT** Some networking software products do not include a function that tells you who is using the system. With the little batch file called WHOSON.BAT (Figure 5), you can quickly see who is actively logged on to the network—providing, of course, that all the network users are using the two

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CIRCLE 507 ON READER SERVICE CARD

LOGON and LOGOUT commands as described above. The syntax is WHOSON.

**MEMO.BAT** Many networks don't come with a mail utility program. MEMO.BAT lets users create simple memos with EDLIN and then save and retrieve them. This routine (Figure 6) will put the time and user stamp in the memo text after it is created. The first parameter gives the type of function that you want memo file to do, read, or send. The second, used only with Send, indicates the user name of the person to whom you wish to send a memo. The syntax is:

```
MEMO r
```

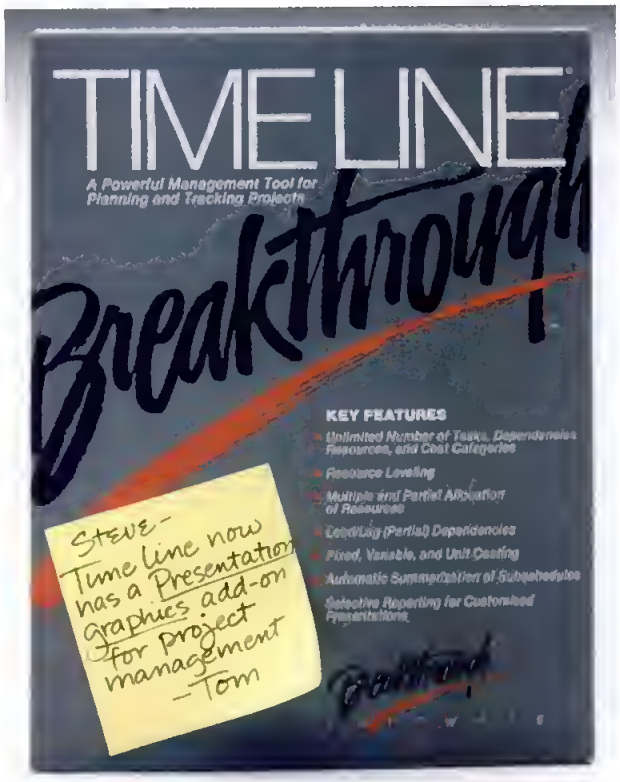
or:

```
MEMO s dave
```

**TASK.BAT** During our testing, we found that we needed some convenient way to start running benchmark task files on each workstation in the network. TASK.BAT (Figure 7) was our solution. It permits remote control of batch jobs running on different network workstations. You can use it to run backups, do training, or to test the network in various ways. The

```
ECHO OFF
CLS
IF .%1. == .R. GOTO READ
IF .%1. == .r. GOTO READ
IF .%1. == ..  GOTO READ
ECHO Enter the memo text below using EDLIN.  > con:
ECHO When finished, file the text            > con:
EDLIN TEMP.FIL
ECHO Linking to network drive                      > con:
(link) d: \\servername\sharename           (example only)
ECHO Memo from: %USER% >> d:\%2\MEMO.BOX
TIME < CR >> d:\%2\MEMO.BOX
COPY d:\%2\MEMO.BOX+TEMP.FIL d:\%2\MEMO.BOX > NUL:
ECHO Memo sent to: %2 > CON:
GOTO END
:READ
(link) d: \\servername\sharename           (example only)
MORE < d:\MEMO.BOX
:END
```

**Figure 6:** *The first two parameters in MEMO.BAT allow you to either read or send a memo. The syntax is MEMO* r *or MEMO* s dave.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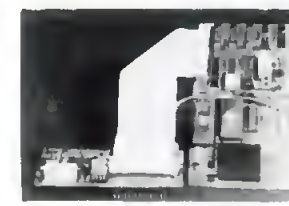

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Says **PC Magazine,** October 14: "AT jr. earned the lab staff's praise for... construction quality."

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CIRCLE 508 ON READER SERVICE CARD

```
ECHO OFF
CLS
IF EXIST C:\FLAGS\ABORT DEL C:\FLAGS\ABORT
:START
CLS
ECHO Waiting for task... > CON:

:WAIT
IF EXIST C:\FLAGS\ABORT GOTO END
IF NOT EXIST C:\FLAGS\GO GOTO WAIT
IF EXIST C:\FLAGS\FILE1 GOTO TASK1
IF EXIST C:\FLAGS\FILE2 GOTO TASK2
IF EXIST C:\FLAGS\FILE3 GOTO TASK3
        .
        .
        .
ECHO Task complete GO terminated > CON:
IF EXIST d:\FLAGS\GO DEL d:\FLAGS\GO
GOTO START

:TASK1
ECHO    TASK #1 started > CON:
TIME < d:\FLAGS\CR > CON:
CLS
C:
CD DOS
DIR
CD \
DIR
DEL d:\FLAGS\FILE1
GOTO EOJ

:TASK2
ECHO TASK #2 started > CON:
TIME < d:\FLAGS\CR > CON:
dir
DEL d:\FLAGS\FILE2

GOTO EOJ

:TASK3
ECHO TASK #3 started > CON:
TIME < d:\FLAGS\CR > CON:
net share                       (example command)
DEL d:\FLAGS\FILE3

:TASKn
  .
  .

:EOJ
ECHO TASK ended > CON:
TIME < d:\FLAGS\CR > CON:
GOTO WAIT

:END

ECHO Task processing terminated > con:
```

**Figure 7:** *TASK.BAT permits remote control of batch jobs running on different network workstations for running backups, doing training, or testing the network. The flag ABORT is used to shut down the TASK manager.*


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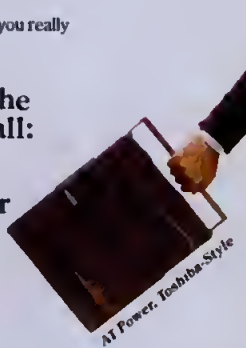


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routine requires several utility files along with TASK and DO.BAT (described below) to work correctly; those most commonly used are CR (a file containing a single carriage retum) and X (a file containing a single character for use in copies).

TASK.BAT uses flags to control its operation. The flags are actually files in a separate shared directory on a networked drive called, here, d:\FLAGS.

The flag file is read by each workstation in the network and, based on the status of the flag file, control is then passed to the proper routine. The flag file GO will start the selected task. When the task is completed, both the flag file and the GO files are then deleted.

**EXPANDABLE BATCH FILE** As you can see, the structure of this routine can be easily expanded to include as much or as little as you want. Anything that can be accomplished without user intervention through a batch job can be implemented in this job stream. Remember, however, that if you want to call one batch job from another, you must precede the name with COMMAND. Since you cannot nest batch files, you must load a copy of COMMAND.COM to run the batch file. Many tasks can be set up to run and then scheduled to be run. Any other names you choose can be substituted for FILEx and TASKx. The flag ABORT is used to shut down the TASK manager.

**DO.BAT** The DO.BAT routine shown in Figure 8 will start a task on any machine; but that machine must have a copy of TASK.BAT. Also the drive D: must be a valid network drive that is shareable by both the task-running machine and the task-controlling machine. Depending on user-specified parameters, TASK may be readied and started later or started immediately. The syntax for DO.BAT is:

```
DO task1
```

or

```
DO task1 go
```

to start the task.

Remember the upper- and lowercase rule in batch file variables: Variables must match in upper- and lowercase as well as in spelling. The parameter test values in the line IF .%1. == .task1. GOTO TASK1 in the batch file must be consistent with the user's input when the batch file is called. It is preferable to make these values all lowercase. If you look at the COPY commands in each task group, you will notice the file X being copied to a flag file. You must remember to include this X file (or any other similar 1-byte file) in your shared directory.

Remember, it's important that the structure of these batch files must match exactly: There must be an entry or routine in TASK.BAT and a corresponding entry in DO.BAT (compare Figures 7 and 8) for each of these services to be used.

```
ECHO OFF
CLS
IF .%1. == .task1. GOTO TASK1
IF .%1. == .task2. GOTO TASK2
IF .%1. == .task3. GOTO TASK3
IF .%1. == .go. GOTO GO
IF .%1. == .abort. GOTO ABORT
ECHO Invalid option > CON:
GOTO END

:TASK1
COPY d:\FLAGS\X d:\FLAGS\FILE1
GOTO INIT

:TASK2
COPY d:\FLAGS\X d:\FLAGS\FILE2
GOTO INIT

:TASK3
COPY d:\FLAGS\X d:\FLAGS\FILE3

:INIT
IF .%2. == .go. GOTO GO
IF .%2. == .GO. GOTO GO
GOTO END

:GO
COPY d:\FLAGS\X d:\FLAGS\GO > NUL:
ECHO Task(s) started at: > CON:
TIME < d:\FLAGS\CR > CON:
ECHO Task will be scheduled to run > CON:
GOTO END


:ABORT
COPY d:\FLAGS\CR d:\FLAGS\ABORT
ECHO Task processor terminated > CON:

:END
```

**Figure 8:** *DO.BAT will remotely start a task on any machine running TASK.BAT. The syntax for DO.BAT is Do task1 or Do task1 go.*

**HEARTFELT BATCH FILES** Good batch files are at the heart of any successful network operation. The ability to create batch files that meet the needs of the network users is a key skill for anyone involved in network administration. The examples described in this article should help you understand some of the basic tools available to you.

The inherent flexibility of a micro-environment LAN system is too often offset by resistance on the part of PC users to learning new commands or procedures. So be prepared to spend much of your time creating an ever-increasing number of batch files for your users. PC

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# AS FAST AS AN AT—OR FASTER

*. . . but much less expensive. Here are four more 80286-based computers that offer AT power and compatibility at prices that will leave room in your budget for add-ons and software.*

When *PC Magazine* put out the call for low-cost AT-compatible personal computers, the machines began to arrive in a swift and steady stream that's still flowing. "The Cheapest ATs Ever" (*PC Magazine*, Volume 5 Number 18) took a close look at eight machines, and although the testing yielded no real superstars, several worthy contenders did emerge. Now, four more of the cheapest ATs ever join the low-cost ranks.

# ALR System 286
# ALR DART

Most IBM AT compatibles bear a striking resemblance to the original, and the System 286 from Advanced Logic Research is no exception. Some minor differences include the logo on the front and cutouts at the back for three DB25 and two DB9 connectors. Inside the machine, however, lurks one striking difference: the system board can accommodate 72 memory chips, for a total capacity of 2 megabytes.

The base ALR System 286 sells for $1,995. Adding a monitor, monitor card, and hard disk brings your total cost to $3,295.

The machine appears well constructed, with a metal chassis and cover. Expansion cards slide easily into the slots. About 10 percent of the system board is underneath the power supply, including half of the battery that provides power to the CMOS RAM. This makes battery replacement a little tricky, but it can be accomplished without removing the power supply.

ALR includes a keyboard that follows the old IBM PC AT layout. This keyboard, manufactured in Thailand, has a nice feel to it, with a consistent resistance to the touch throughout a key's full travel. Green LEDs are embedded in the NumLock, ScrollLock, and CapsLock keys, but under normal office lighting it is difficult to tell whether the LEDs are on or off.

**QUALITY OR LUCK?** The monitor offered with the fully configured System 286 is the amber Quimax DM-14. The monitor, which rests on a tilt-and-swivel base, has a modern look, but the only available controls are contrast and brightness. However, due to either stiff quality control or sheer luck, the display quality of the unit tested was excellent, so no other controls were necessary.

*The system board for Advanced Logic Research's System 286 and DART accommodates 72 memory chips. This, along with an on-board parallel port and dual serial port board, makes for substantial savings on memory expansion.*

The system board contains a DIP switch with eight settings and a variety of jumpers that let you set the system configurations for the appropriate amount of RAM (512K bytes through 2 megabytes), the type of video, the parallel port, and the clock speed. The clock speed is controlled by a jumper setting that switches between 6 and 8 MHz.

PC Labs benchmark tests performed at the System 286's 8-MHz speed showed results comparable to other 80286-based machines running at that speed. The hard disk drive sold with the fully configured System 286 is a 20-megabyte Seagate ST-4026. The ST-4026's measured average access time was a respectable 39.54 milliseconds.

The dual-port serial card included with the base System 286 configuration has two connectors, a DB25 and DB9. Both support the RS-232 standard, and the DB25 connector supports the RS-422 as well.

ALR's documentation includes all the information you need to get started, as well as helpful technical details such as a list of advanced diagnostic error messages. Although the packaging of the manual is not particularly attractive, the content is certainly useful.

In case 8 MHz isn't fast enough for you, ALR markets a 10-MHz version called the DART. The two computers are almost identical; the DART, however, has a 10-MHz 80286 processor, a 20-MHz crystal, 120-nanosecond memory chips instead of 150 nanosecond, and minor design changes to the system board.

Benchmark tests show that the DART, as expected, runs approximately 20 percent faster than the 8-MHz System 286. The base configuration adds another 512K bytes of RAM to the System 286's configuration and sells for $2,495.

The ALR System 286 is not the cheapest AT alternative, but it offers some solid trade-offs. Foremost is the potential for 2

## FACT FILE

**ALR System 286**
**ALR DART**
Advanced Logic Research
10 Chrysler Ave.
Irvine, CA 92718
(714) 581-6770
**List Price:** System 286, $3,295; DART, $3,645 (tested configurations).
**In Short:** Reliable performance and high-quality components make these computers good choices even though they are priced higher than some of their competitors.
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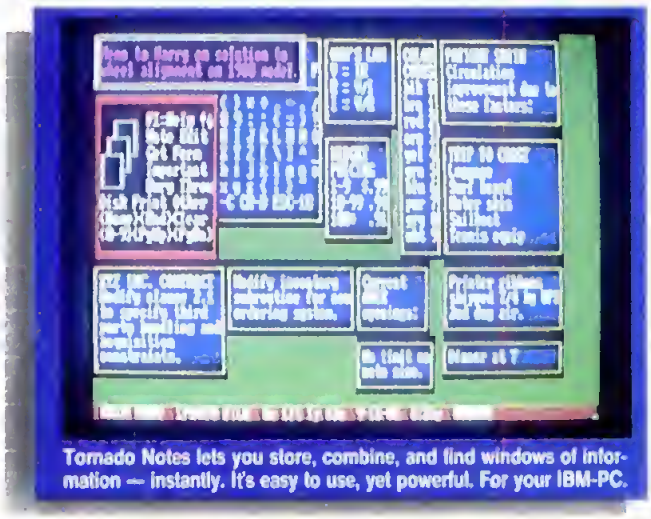

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megabytes of on-board memory, which should save you some money on memory expansion. The on-board parallel port and the dual-serial port board also represent savings. In addition, the System 286 is one of the few compatibles that earns high marks for each component—system unit, keyboard, and monitor.

## Tech PC AT Desktop

It's the rare AT-style computer vendor that doesn't attempt to improve on the original IBM model in some way, but this is the case with Tech Personal Computers. Its Tech PC AT Desktop duplicates the features of IBM's PC AT right down to the 512K bytes of RAM on the system board. Of course, the suggested list price of the Tech PC AT Desktop is a whole lot different from IBM's price—just $1,399 for the standard configuration.

That base price includes an 80286-based system unit, 512K bytes of RAM, a 1.2-megabyte floppy disk drive, and a Western Digital hard and floppy disk controller. One unusual unique minor feature is a toggle switch that protrudes from the back of the machine and lets you change the clock speed from 6 to 8 MHz. The base of the switch is embedded in a block of epoxy that holds two crystals. A wire connects the block to the system board. The whole thing looks as if it were fabricated in someone's basement, which is probably why IBM didn't include one in the AT.

Another more important aspect of the Tech PC AT Desktop's construction also leaves something to be desired. The metal back of the chassis bends easily, and if you try to insert an expansion board into an outer slot, the system board bends, too. This weakness makes it difficult to seat boards properly in the slots and is potentially dangerous.

**PC MAGAZINE FACT FILE**

**Tech PC AT Desktop**
Tech Personal Computers
2131 S. Hathaway
Santa Ana, CA 92705
(714) 754-1170
**List Price:** $2,148 (tested configuration).
**In Short:** A low-priced compatible that looks and acts like an IBM PC AT but is not built nearly as well.

CIRCLE 682 ON READER SERVICE CARD

**PERIPHERALS AND OPTIONS** The keyboard, which comes from Thailand, is laid out like the older IBM PC AT keyboard. I liked the feel of the keyboard, which offers firm, constant resistance. The NumLock, ScrollLock, and CapsLock keys have green LEDs, but it's difficult to tell whether they are on or off under normal office lighting.

The review machine did not include a monitor, though the company sells one as an option. It did include the optional 30-megabyte hard disk drive, a 360K-byte floppy disk drive, monochrome/graphics adapter card, and a parallel/serial I/O card. This configuration plus a monochrome monitor sells for $2,148. The hard disk, a Seagate 4038, tested at a fast 29-millisecond access time. At 8 Mhz, the Tech PC AT Desktop's performance was comparable to that of other 8-MHz AT compatibles we tested.

The Tech PC AT Desktop performs respectably and is priced attractively enough to merit consideration. Be aware of the chassis's construction flaw, however, before you buy.

*The Tech PC AT Desktop is attractively priced—$1,399 buys you an 80286-based system unit, a floppy disk drive, a keyboard, and a disk controller card. A toggle switch lets you switch the microprocessor's clock speed between 6 and 8 MHz.*

## PC's Limited 286 12

The PC's Limited 286 12 feels more like an enhanced version of the IBM PC AT than a mere copy. Its most notable feature is its 12-MHz clock speed, which makes it twice as fast as the original IBM PC AT. The 286 12's speedy processor resides inside a streamlined system unit that's about 12 percent smaller than the AT's chassis. Inside, even the system board is downsized; it has fewer chips because it uses four VLSI chips.

The 286 12 competes on price as well as features. The base system, which includes 1 megabyte of RAM and a 1.2-megabyte floppy disk drive, costs only $2,695. It's not the cheapest AT compatible on the market, but you get good value for your extra dollars.

The 286 12 is styled like an IBM AT,

Processor speed is the telling factor when you compare the 6- and 8-MHz IBM PC ATs with 6-, 8-, 10-, and 12-MHz compatibles. If speed is your primary consideration, the PC's Limited 286 12 and ALR DART are the clear choices.

When you examine the results for the Disk Access benchmark test, keep in mind that several manufacturers offer several different hard disk models with their computers. Even when storage size remains constant, the test results will fluctuate to reflect different drive-speed ratings or tolerances. Processor speed does not affect hard disk access time; it's coincidental that the machines with faster clock speeds here have faster hard disks as well.

These results were normalized against the 6-MHz IBM PC AT; times for the 8-MHz IBM PC AT are included for comparison.

## PC Labs Benchmark Tests: Low-Cost AT Compatibles

### Performance Times

(Times given in seconds and decimal seconds)

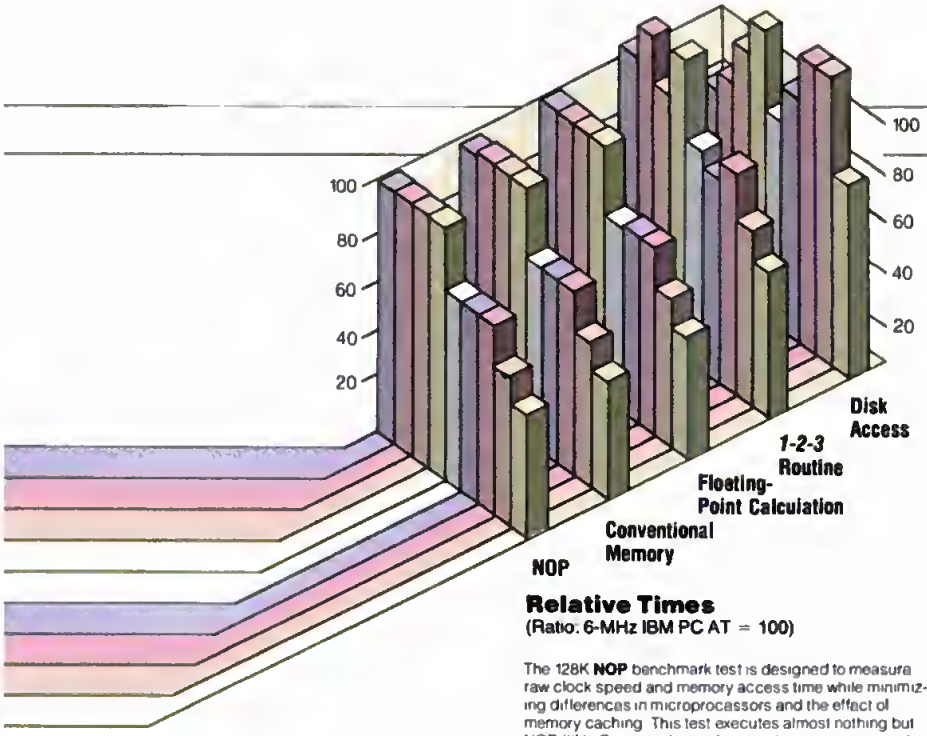
| Product | NDP | Conventional Memory | Floating-Point Calculation | 1-2-3 Routine | Disk Access (Random) |
|---|---|---|---|---|---|
| PC's Limited 286 12 (6 MHz) | 5.60 | 1.79 | 46.63 | 78.65 | 26.58 |
| Tech PC AT Desktop (6 MHz) | 5.60 | 1.81 | 46.63 | 87.32 | 29.16 |
| IBM PC AT (6 MHz) | 5.58 | 1.81 | 46.61 | 74.31 | 34.79 |
| ALR System 286 (6 MHz) | 5.58 | 1.80 | 46.63 | 87.31 | 39.54 |
| Tech PC AT Desktop (8 MHz) | 4.20 | 1.32 | 34.38 | 64.72 | 29.16 |
| IBM PC AT (8 MHz) | 4.17 | 1.32 | 34.33 | 60.46 | 33.72 |
| ALR System 286 (8 MHz) | 4.17 | 1.32 | 34.38 | 64.72 | 39.54 |
| ALR DART (10 MHz) | 3.35 | 1.04 | 27.35 | 51.76 | 39.54 |
| PC's Limited 286 12 (12 MHz) | 2.78 | 0.85 | 22.46 | 42.85 | 26.58 |

(Results for the Conventional Memory test are an average of the Read and Write times.)

## Low-Cost ATs: Summary of Features

| Product/ Manufacturer | Base price | Base price includes | Price of config. tested | Configuration tested | Options |
|---|---|---|---|---|---|
| **Tech PC AT Desktop**<br>Tech Personal Computers | $1,399 | 512K RAM, 1.2-Mbyte floppy disk drive, hard and floppy disk controller | $2,148 | All features of base model, 30-Mbyte hard disk, monochrome monitor, mono/graphics card, serial/parallel port card | 360K-byte floppy disk drive, $149; 30-Mbyte hard disk, $400; 5-Mbyte RAM expansion board (up to 16 Mbytes available), $800; monochrome monitor and Hercules-compatible mono/graphics card with parallel port, $200; color monitor and color/graphics card with parallel port, $500; enhanced color monitor and enhanced graphics card, $800; 25-Mbyte tape backup, $800 |
| **ALR System 286**<br>Advanced Logic Research | $1,995 | 512 RAM, 1.2-Mbyte floppy disk drive, Western Digital hard and floppy disk controller, parallel port, dual-port serial card (only one port active) | $3,295 | All features of base model, 1 Mbyte RAM, 20-Mbyte hard disk, Quimax monochrome monitor, mono/graphics card | *1.2-Mbyte or 360K-byte floppy disk drive, 20- to 80-Mbyte hard disks, Challenger card (add-on with up to 4 Mbytes RAM and serial/parallel game port combinations), serial card with 2 or 4 ports, mono/graphics card, color/graphics card, ALR Vivid EGA and monochrome monitor, 8 or 8- and 10-MHz speed option, 101-key keyboard |
| **ALR DART**<br>Advanced Logic Research | $2,495 | 1 Mbyte RAM, 1.2-Mbyte floppy disk drive, Western Digital hard and floppy disk controller, parallel port, dual-port serial card (only one port active) | $3,795 | All features of base model, 1 Mbyte RAM, 20-Mbyte hard disk, Quimax monochrome monitor, mono/graphics card | *1.2-Mbyte or 360K-byte floppy disk drive, 20- to 80-Mbyte hard disks, Challenger card (add-on with up to 4 Mbytes RAM and serial/parallel game port combinations), serial card with 2 or 4 ports, color/graphics card, ALR Vivid EGA and monochrome monitor, 101-key keyboard |
| **PC's Limited 286 12**<br>PC's Limited | $2,695 | 1 Mbyte RAM, 1.2-Mbyte floppy disk drive | $5,156 | All features of base model, 40-Mbyte hard disk, 60-Mbyte tape backup, EGA monitor, EGA card, serial/parallel port card | 1.2-Mbyte floppy disk drive, $1,495; 20- to 80-Mbyte hard disks, $579 to $1,495; 60-Mbyte tape backup, $795; monochrome, color, and EGA monitors, $129 to $459; video card, $99; serial/parallel port card, $159 to $269; modem, $159 to $179 |

●—Yes ○—No *Prices of individual components set by ALR dealers.




**Relative Times**
(Ratio: 6-MHz IBM PC AT = 100)

The 128K **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentials, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 3.0.

The **Conventional Memory** benchmark test allocates 256K bytes of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory.

The **Disk Access** benchmark test, from Core International, Inc., measures the hard disk's seek time, or how fast the drive responds to the disk controller's instructions. The test program performs three measurements on the speed at which the drive head moves: track to adjacent track, track to randomly selected track, and the average of a series of random track accesses.

Designed for a 640K environment, the **1-2-3 Routine** benchmark test assesses the computational speed and RAM-management capabilities of the machine by using a *1-2-3* macro that performs a series of both global and individual worksheet tasks. The macro copies and recalculates a 10-cell range 499 times, moves 1,000 cells, deletes 1,000 cells, and then systematically clears the spreadsheet.

| Ports included in base price | Slots | Power supply (watts) | Reset key | Keyboard style | Claimed clock speed (MHz) | Controller card | Warranty | IBM EGA compatible | Above Board compatible | BIOS manufacturer |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | 8 | 195 | ○ | Old AT | 6 and 8 | Handles 2 hard, 2 floppy disk drives | 1 year, parts and labor | ● | ● | Award Software |
| 1 serial, 1 parallel | 8 | 200 | ○ | Old AT | 6 and 8 | Handles 2 hard, 2 floppy disk drives | 1 year, parts and labor | ● | ● | Phoenix |
| 1 serial, 1 parallel | 8 | 200 | ○ | Old AT | 8 and 10 | Handles 2 hard, 2 floppy disk drives | 1 year, parts and labor | ● | ● | Phoenix |
| ○ | 8 | 192 | ○ | Old AT | 6 and 12 | Handles 2 hard, 2 floppy disk drives | 1 year, parts and labor | ● | ● | PC's Limited |

PC MAGAZINE FACT FILE

**PC's Limited 286 12**
PC's Limited
1611 Headway Circle, Bldg. 3
Austin, TX 78754
(512) 339-6800
**List Price:** $5,156 (tested configuration).
**In Short:** A well-designed computer that offers super-high performance at an affordable price and lots of expansion options.
CIRCLE 601 ON READER SERVICE CARD

but it is not as wide (18.5 versus 21.1 inches). Take off the cover and you'll find that it has just one disk drive bay instead of the AT's two. The single bay can hold up to three half-height drives. A metal brace connects the front and back of the chassis along the left side of the computer, giving the unit a sturdy appearance. This brace has a drawback, though: if you want to install a card in the leftmost expansion slot, you must remove the brace first.

The system board is narrow, but, because of the reduced width of the chassis, a small part of the board is tucked under the power supply. Some AT compatibles have their batteries in that difficult-to-reach spot, but the battery for the 286 12's CMOS RAM is conveniently located at the front of the unit.

The system board holds 1 megabyte of RAM and contains four custom VLSI chips from Chips and Technologies. An 8-position DIP switch lets you choose color or monochrome, memory size, and other parameters. But the switch is located under the board that resides in the leftmost slot. If you use a board in this slot and you want to change a switch setting, you may find yourself removing the chassis brace and the board to do it. The system board has a total of eight expansion slots. Unlike in the IBM AT, the two 8-bit slots are grouped together at the left-hand side of the system board.

**SWITCH-SELECTABLE SPEED** The PC's Limited 286 12 runs at 12 and 6 MHz. Its processing speed is not due solely to the 24-MHz crystal on the system board. Its 100-nanosecond dynamic RAM chips and 8-MHz DMA, counter/timer, interrupt controller, and clock generator chips also support speeds up to 16 MHz. Also, the 80286 chip used in the machine is a 12.5-MHz rated chip. You can change the speed from 12 MHz to 6 MHz through a keyboard control sequence, even while the computer is on.

The keyboard, which is manufactured by Maxi-Switch, has the old-AT-style layout and is very light compared to the IBM keyboard. A switch located on the bottom of the keyboard lets you interchange the Esc and Tilde keys to put the Esc key back in the upper-left-hand position if you like it there. The keys themselves present an initial resistance to the touch that I personally don't care for.

The review unit included a PC's Limited EGA board (called EGAds!) and enhanced color monitor. The board, which holds 256K bytes of video RAM, sells for $269, and the monitor for $479. The monitor has a fine display with just one notable flaw: characters in the rightmost column of the screen are condensed in width.

PC's Limited sells an optional Tandon 40-megabyte hard disk drive for $819, along with a utility that can divide the drive into two 20-megabyte drives called C and D. The PC Labs benchmark test rated the drive at a 26.58-millisecond access time, a performance that exceeds IBM specifications for the PC AT by more than 30 percent. A 60-megabyte, ¼-inch tape drive for backup, which sells for $795, is another useful option.

An interesting feature of the 286 12 is a front-panel display called SmartVu. A red LED bar graph indicates processor activity, and a green LED matrix linked to an internal diagnostics program can show you information such as the drive in use and the track number, or it can display a scrolling message. SmartVu can help you pinpoint the problem if you have trouble with your machine, and it can help the PC's Limited technical support staff as well. If you find the back-and-forth movement of the red distracting, you can turn the panel off from the setup menu.

Unlike other AT compatibles, the 286 12 stores its setup routine in ROM. If any hardware discrepancies arise during boot-up, the usual setup message appears. But

*Its 12-MHz processor and 100-nanosecond dynamic RAM chips distinguish the PC's Limited 286 12 from the crowd, as does the SmartVu, a unique front display panel that can help you quickly pinpoint the problem if you have trouble with the machine.*

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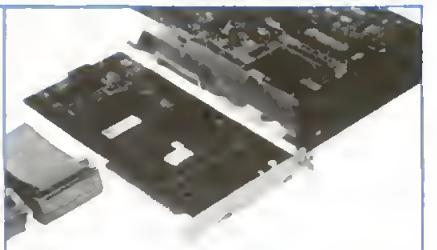

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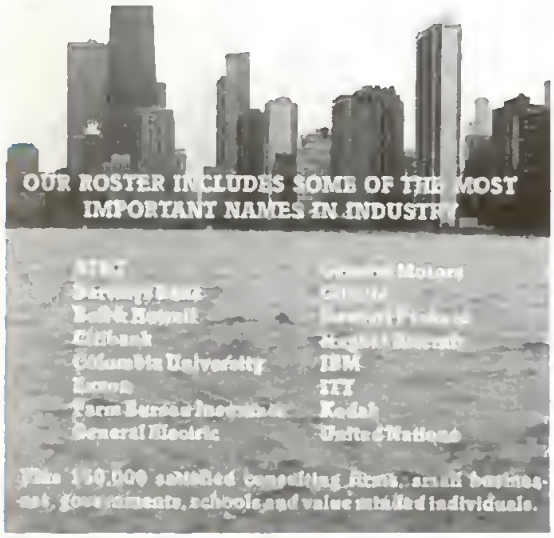


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| **IOmega** *Bernoulli Box/Dual MB Drives* | $1,710.00* | *(36 94)* |
| ▶ **PC Network** *10MB Internal 1" Height Autoboot Drive by Seagate or Shugart* | 280.00* | *(6 24)* |
| **PC Network** *10MB Tape Backup Same Unit used in Compaq's DeskPro* | 340.00* | *(9 48)* |
| **PC Network** *20MB Tape Backup Half Height w/controller* | 495.00* | *(10 88)* |
| ▶ **PC Network** *Half Height DS/DD Drive* | 75.00* | *(1 68)* |
| **Tandon** *20MB Hard Card* | 435.00* | *(9 40)* |
| ▶ **THE** *'20 + 20' Storage System w/20MB Tape Backup Combo Kit* | 699.00* | *(15 10)* |
| ▶ **THE** *'20MB' 20MB Internal 1/2 Height Autoboot Drives by Seagate or Microscience* | 357.00* | *(7 93)* |

#### MEMORY CHIPS

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| ▶ **64K Memory Upgrade Kits** *(9 chips)* | $7.75* | *(1.00)* |
| ▶ **64K Dynamic Ram Chips** *(Each)* | 1.00* | *(1.00)* |
| ▶ **256K Dynamic Ram Chips** *(Each)* | 2.90* | *(1.00)* |
| ▶ **128K AT Mother Board Chips** *(Each)* | 3.90* | *(1.00)* |
| ▶ **Intel** *8087-2 Processor* | 88.50* | *(2.15)* |

#### MODEMS

| | | |
|---|---|---|
| ▶ **Hayes** *Smartmodem 2400* | $525.00* | *(5.00)* |
| **Hayes** *Smartmodem 1200B with new Smartcom II VT 100 Emulator* | 315.00* | *(2.50)* |
| **Hayes** *Smartmodem 1200* | 340.00* | *(5.00)* |
| **U.S. Robotics** *Courier 2400BPS Modem* | 345.00* | *(5.00)* |
| **U.S. Robotics** *Password* | 172.00* | *(2.50)* |
| **ALL THE MODEMS ARE 100% HAYES COMPATIBLE** | | |
| ▶ **THE** *'1200 Com External* | 119.00* | *(2.58)* |
| ▶ **THE** *'2400 Com External* | 259.00* | *(5.54)* |
| ▶ **THE** *'1200 Com Internal w Free PC Talk III* | 109.00* | *(2.50)* |
| **THE** *'2400 Com Internal w Free PC Talk III* | 197.00* | *(2.50)* |

#### MONITORS

| | | |
|---|---|---|
| **Amdek** *Video 310A Amber TTL Monitor* | $120.00* | *(3.00)* |
| **Amdek** *Color 600 High Res RGB Monitor* | 365.00* | *(7.88)* |
| **Amdek** *Color 722 NEW! Enhanced* | 424.00* | *(9.15)* |
| **Magnavox** *Amber IBM Type TTL Monitor* | 79.00* | *(5.00)* |
| **Magnavox** *14" RGB Color Monitor 640 x 240* | 250.00* | *(5.00)* |
| **NEC** *JC 1401 Multisync RGB Color Monitor* | 530.00* | *(11.45)* |
| **Princeton** *HX-12 RGB Monitor* | 369.50* | *(7.98)* |
| **Princeton** *HX-12E RGA or EGA Monitor* | 420.00* | *(9.29)* |
| **Princeton** *MAX-12E* | 138.00* | *(5.00)* |
| *Supports Either Mono or RGB Cards* | | |
| **Taxan** *630 High Res RGB Monitor* | 383.00* | *(8.27)* |
| **Taxan** *640 Highest Res (720x400)* | 439.00* | *(9.27)* |

#### MULTIFUNCTION CARDS

| | | |
|---|---|---|
| **AST** *SixPakPremium * w/0K* | $315.00* | *(2.50)* |
| ▶ **AST** *SixPakPlus * with 64K* | 139.00* | *(2.50)* |
| **AST** *I/O Plus II "* | 129.50* | *(2.50)* |
| ▶ **AST** *Advantage for AT* | 325.00* | *(2.50)* |
| **Orchid** *Conquest* | 220.00* | *(2.50)* |
| **Orchid** *Tiny Turbo 286* | 399.00* | *(2.50)* |
| **Tecmar** *Captain Multifunction Card 0/K* | 109.00* | *(2.50)* |
| ▶ **THE** *'2MB RAMCard Intel spec card w 0K* | 88.00* | *(2.50)* |
| ▶ **THE** *'Multi 384' A functional clone of AST's SixPakPlus * w 0K 1 serial 1 parallel 1 game port a clock calendar and 3 software standard* | 97.00* | *(1.82)* |
| ▶ **THE** *'Multi I/O' I/O Plus Clone Ser Par Game Clock Standard* | 80.00* | *(2.50)* |

#### PRINTERS

| | | |
|---|---|---|
| **Citizen** *MSP-10 NEW! 160CPS/80COL/Fric + Trac* | $259.00* | *(4.86)* |
| **Citizen** *MSP 15 NEW! 160CPS/132COL/Fric + Trac* | 340.00* | *(7.34)* |
| **Citizen** *MSP 25 NEW! 200CPS/132COL/Fric + Trac* | 435.00* | *(9.40)* |
| **Citizen** *Premiere 35 NEW! 35CPS Daisywheel/132COL/Fric + Trac* | 420.00* | *(9.07)* |
| **Citizen** *120-D 120/25CPS 10" w/Tractor* | 168.00* | *(3.65)* |
| **Epson** *FX-85 160CPS 10" Par* | 355.00* | *(7.45)* |
| ▶ **Epson** *FX-286 NEW! 200CPS 40CPS NLQ* | 440.00* | *(10.91)* |
| ▶ **Epson** *LQ-1000 NEW! 180CPS/60CPS NLQ* | 699.00* | *(15.10)* |
| ▶ **Epson** *LX-86 120CPS 8.5 Friction Feed Parallel w NLQ Switch* | 219.00* | *(4.35)* |
| ▶ **Epson** *LQ-800 180COL/60CPS Parallel* | 519.00* | *(10.99)* |
| ▶ **Epson** *LQ-2500 108CPS 132COL Par Ser* | 995.00* | *(19.90)* |
| ▶ **EpsonEX-800** *80COL Parallel Matrix* | 445.00* | *(9.10)* |
| ▶ **Epson** *EX-1000 132COL Parallel Matrix* | 629.00* | *(12.58)* |
| **NEC** *2050 20CPS Letter Quality Printer* | 570.00* | *(11.88)* |
| **NEC** *3550 33CPS Letter Quality Printer* | 690.00* | *(14.90)* |
| **NEC** *8850 55CPS Printer* | 949.00* | *(20.50)* |
| **NEC** *Pin Writer P-6 216/180/65CPS 10"* | 415.00* | *(8.86)* |
| **NEC** *Pin Writer P 7 180/65CPS 132COL* | 535.00* | *(11.58)* |
| **Panasonic** *KX-P1091 120/25/22CPS* | 220.00* | *(4.75)* |
| **Panasonic** *KX P1092 180 CPS w Tractor* | 329.00* | *(7.11)* |
| **Panasonic** *KX-P1592 180 CPS 15" w/Trac* | 408.00* | *(8.77)* |
| **Toshiba** *NEW! P341 210CPS/132COL* | 649.00* | *(14.02)* |
| **Toshiba** *351 Par/Ser 288CPS/132COL* | 959.00* | *(20.71)* |

#### VIDEO CARDS

| | | |
|---|---|---|
| **Hercules** *Color Card w/Parallel Port* | $126.00* | *(2.50)* |
| **Hercules** *Monochrome Graphics Cards* | 192.00* | *(2.50)* |
| **Paradise** *Autoswitch EGA* | 336.00* | *(2.50)* |
| **Orchid** *Turbo EGA Card* | 588.00* | *(2.50)* |
| **Quadram** *Quad EGA +* | 323.00* | *(2.50)* |
| ▶ **THE** *'EGA Plus' w 256K and printer port* | 220.00* | *(2.50)* |
| ▶ **THE** *'H720' Mono Graphics w parallel port 100% Hercules Compatible!* | 89.00* | *(2.50)* |
| ▶ **THE** *'Color Card' 100% IBM Compatible* | 69.00* | *(2.50)* |

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| | | |
|---|---|---|
| ▶ **Brand Name DS/DD Diskettes (Box of 10)** *Guaranteed for Life! Not Generic* | $7.95* | *(1.00)* |
| ▶ **DS/DD Bulk Pack Special** *Packaged in 50 with sleeves and labels Guaranteed for Life!* | ea. 44* | |
| ▶ **PC Network** *Replacement 130 Watt IBM PC Power Supply—Gives you PC (Old or New) the same capacity as an XT. Good for add-in tape drives (without need for a piggyback unit) and large capacity disk drives* | 70.00* | *(2.70)* |
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## PC MAGAZINE EDITOR'S CHOICE

*For the ultimate balance between price and performance, none of the AT compatibles reviewed here is the perfect solution. Contenders reviewed in a previous issue offer better trade-offs (see "The Cheapest ATs Ever," PC Magazine, Volume 5 Number 18).*

*Depending on what features interest you most, however, you may find one of these three machines particularly appealing. The Tech PC AT Desktop has two factors going for it: it's very inexpensive and very close to the IBM original in appearance and performance. The PC's Limited 286 12 is the highest-priced computer here, but it's still less expensive than an IBM PC AT. And if time is a precious commodity for you, the 12-MHz speed will win you over. The most judicious choice here might be the ALR System 286, a price-conscious computer that offers reliability and attractive features.*

when you press F1, the setup menu is immediately displayed on the screen. If there is a memory discrepancy, the program determines the correct amount of memory automatically. You can call the setup menu at any time from the keyboard by pressing Ctrl-Alt-Enter.

The PC's Limited 286 12 offers features and performance at an affordable price. (Don't be misled by the "tested configuration" price; PC's Limited provided a fully loaded unit for review, complete with the optional tape backup unit, EGA board, and EGA monitor.) A 10-MHz model, the 286 10, is available for $2,295, and the 8-MHz PC's Limited 286 sells for a very reasonable $1,495.

Although compatible with the IBM PC AT, the PC's Limited 286 12 is certainly not a clone. Thoughtful construction, intelligent design, and the astute marketing sense behind it should make this machine another PC's Limited success. PC


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CIRCLE 476 ON READER SERVICE CARD

*First new ¼ inch cartridge since 1971*

# Cartrex introduces the first, brand-new, ¼-inch tape cartridge technology in over 15 years for some fundamental technical reasons. . .

**. . .and today's tape drive need for 400% increase in tape speed, 500% increase in track density, 1000% increase in bit densities, and 3000% increase in bits/second, are just a few. Read on to get the complete story.**

### Why a new cartridge

With the significant increases in tape drive capacity, system reliability demands a tighter tolerance cartridge. Most tape drive users aren't aware that all of the tensioning, tolerance, and data reliability issues are virtually all a function of the tape cartridge.

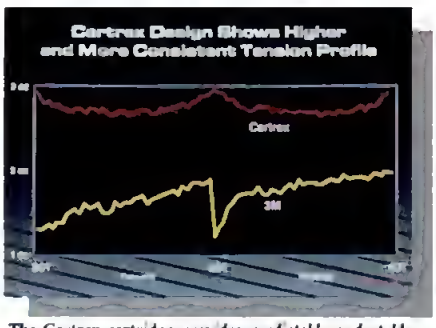
When 3M announced its cartridge in 1971, it was designed for a low capacity tape drive with less than 3 megabytes—2.88 to be exact. The tape was low in density—1600 bits per inch with only 4 tracks and 300 feet of tape.

The tolerances required for the tape drives of the early 1970's were fine for then, but today's tape drives require much tighter tolerance. Today's tape cartridges must work with drives that have 9 or more tracks and bit densities as high as 12,000 bits per inch on 600 feet of tape. That means capacity increases of 2,000 percent packed into the same cartridge.

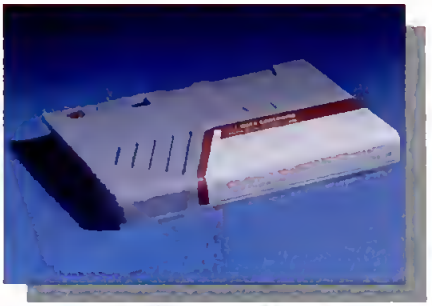
The reasons that yesterday's cartridge technology simply won't work properly in today's high capacity drives is inherent in the cartridge design. The three culprits that make cartridge tolerances so important are fluctuating tape tension, redeposit nodules, and instantaneous speed variations (or ISV).

### Tape Tension

Tape tension at the read-write head is important because the tape drive's electronics expect data to arrive at a constant rate. Consistent tape tension is a function of the cartridge tensioning mechanism. The new Cartrex cartridge tensioning design, based on a mechanical differential between two stiff belts, provides very predictable results. The historic 3M design—used by 3M and DEI—uses an elastic belt coupled with drag friction at the rear pulley to create tension. The accompanying graph shows the significant improvement the Cartrex cartridge design offers over the conventional design.




*The Cartrex cartridge provides predictable and stable tension. Compare it to the tension variation of the conventional cartridge design. The consistent Cartrex tension virtually eliminates data errors and data loss from head-to-tape separation and redeposit nodules that can occur with fluctuating, low-to-high tension performance.*



*The new Cartrex ¼-inch tape cartridge is the first new tape cartridge design in almost a decade and a half. Tape drive manufacturers now have a new cartridge technology which allows them to advance today's and tomorrow's drive performance.*

### Redeposit Nodules

Redeposit nodules are the insidious flakes of tape media that break off from the edges of the tape and get dragged to the edge of the read-write head. If the tension is low, or becomes low when the tape starts or reverses, the flakes slide past the edge, get smeared across the head, and reduce its ability to read data.

The free play in the two tape reels combined with the tape guides are the primary culprits in creating these redeposit nodules. As the tape enters the guide from the tape pack, the tape guide aligns the tape by balancing the tension at the edges of the tape. Uneven edge tension not only causes media to flake off causing redeposit nodules, but data is lost due to the "coining" or "scalloping" effect.

Cartrex eliminated the cause of the tape coining or scalloping with a barrel-shaped roller placed in front of the tape guide. The roller positions the tape and drops the edge tension to zero. By using this roller, the possibility of media flaking off and creating redeposit nodules is virtually eliminated.

### Instantaneous Speed Variation (ISV)

Instantaneous speed variation is exactly what it sounds like—small, instantaneous changes in tape speed as it crosses the tape head. At slow tape speeds and low bit densities—like the 1971 standard of 30 inches per second and 1,600 bits per inch—ISV wasn't as big a problem. At that time, the bits were crossing the head at 48,000 bits per second.

Today, however, the story has changed. Ninety inches per second and 8,000 bits per inch mean that 720,000 bits cross the head every second. A 1,500% increase. As you may have guessed, 1971 speed fluctuations in the 48,000 bits per second range made reading data difficult for tape drive electronics. But today, when the electronics have to guess whether or not the bit rate of 720,000 bits per second is accurate, the electronics can become overwhelmed.

The Cartrex tensioning mechanism relieves the overload placed on the electronics with respect to ISV. The longitudinally stiff belts ensure tension at all times. The stiff belt overpowers variations that exist with the 3M elastic belt cartridges. The barrel roller guides, in addition to reducing the edge pressure to zero, tend to dampen out any residual ISV effects.

*High speed tape seldom enters tape guides parallel to the top and bottom, even with improvements to the tape reel hub designs. The edge pressures which result create "scalloping" or "coining" on the tape. The effect is data loss due to head-to-tape separation, flaking media that smears across the head, and "redeposit nodules" that create hard errors.*

### Never a Single Issue

Your tape drive seldom has the luxury of dealing with an isolated problem. It's usually a combination of ISV, redeposit nodules, and tension problems all together. Now you understand why Cartrex developed a modern cartridge alternative.

### Where to get it

Not only has Cartrex improved on the industry's 15 year old technology, they have done it for a competitive price.

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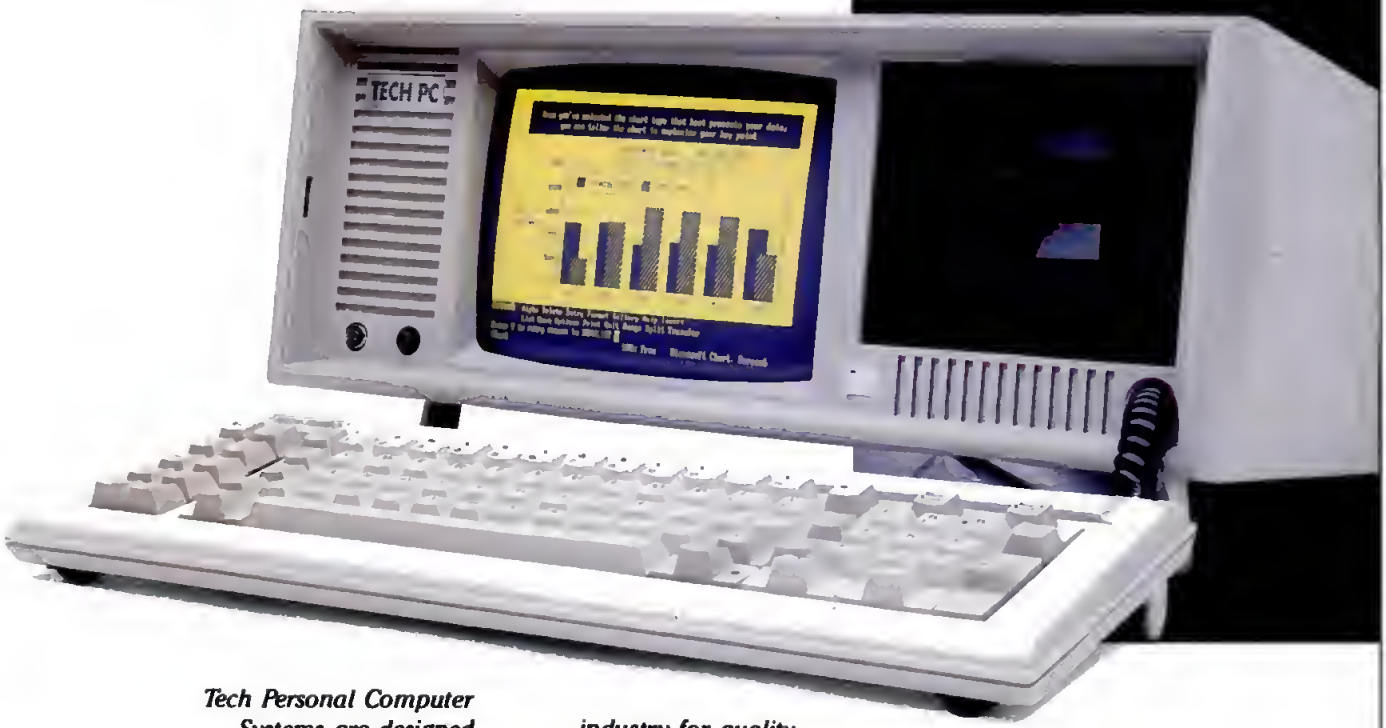


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CIRCLE 504 ON READER SERVICE CARD

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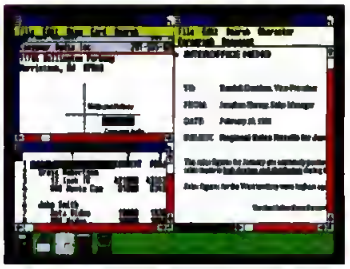

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Note: Photos show color and resolution obtained on an IBM PC equipped with an IBM Enhanced Graphics Adapter. Monochrome display is generated when an IBM Color/Graphics Adapter or compatible graphics adapter card is used.

**CIRCLE 355 ON READER SERVICE CARD**

# SUPERCHARGING XT HARD DISK PERFORMANCE

Mention PC performance, and hard-core power users will spin yarns about souping up their 80286-based desktop wonders with clock crystals that operate in the FM band, disks so fast they scorch data, and special tricks confided to them by one of the aboriginal witch doctors who developed the more esoteric modules of DOS. Somehow the 3 million or so 8088-based IBM PCs and XTs and the untold millions of compatibles are forgotten when performance is the issue.

You can, however, improve your 8088-based system's performance and your own productivity in several ways. Software developers have created caching programs to speed up hard disks (see "Getting the Most Out of Your Hard Disk," *PC Magazine*, Volume 5 Number 5), and the many new accelerator boards let you boost processor performance, although sometimes they slow down disk access (see "Accelerator Boards: Power for a Price," *PC Magazine*, Volume 5 Number 15). But hidden from the headlines and microprocessor horse races, several hardware developers have created modest miracles that promise to boost the speed, capacity, and usefulness of ordinary PCs and XTs by quickening the pace at which data flows both to and from their hard disk storage systems.

Advances have been made on several fronts. The hard disks themselves are being so honed and refined that the fastest of today's hard disk drives can retrieve a random byte of data from disk five times faster than the drive that came with the original XT. And disk controllers—the electronics that actually direct the movements of the hard disk head and turn mag-

*If you've worked on an AT, your XT's hard disk may now seem unbearably slow. You can speed it up and increase storage with a new hard disk or controller.*

netic pulses into useful data—can now boast on-board buffering and new data-coding schemes. Even the arrangement of the storage units on the disk can now be modified to improve data access.

It sounds too good to be true. Can you really get AT performance from an XT system, as one disk maker claims? To find out, PC Labs tested and compared each of these disk innovations, individually and in combination.

The results were surprising. The XT standard for hard disk performance, which had astounded us only a few years ago, proved to be a modest one, indeed. The various technical tours-de-force we tried all improved disk performance to some degree. And when these hardware innovations were optimally combined and linked with DOS, we were able to speed up data access and transfer significantly.

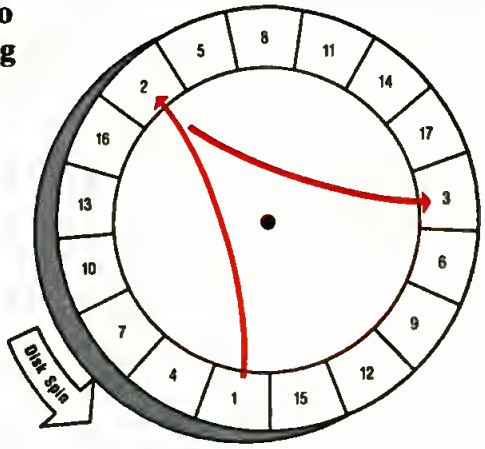
Some of our long-held beliefs—for instance, that the 8088 microprocessor can't benefit from faster disk access—fell by the wayside. And others—like the importance of providing adequate sector buffering—were reinforced.

No mere change in its hard disk subsystem will put the humble 8088-based XT on a par with its muscular sibling, the AT. But paying some attention to your hard disk can mean the end of a lot of waiting for the red hard disk drive light to go out and the beginning of better performance in disk-intensive applications.

## Two Approaches to Sector Interleaving

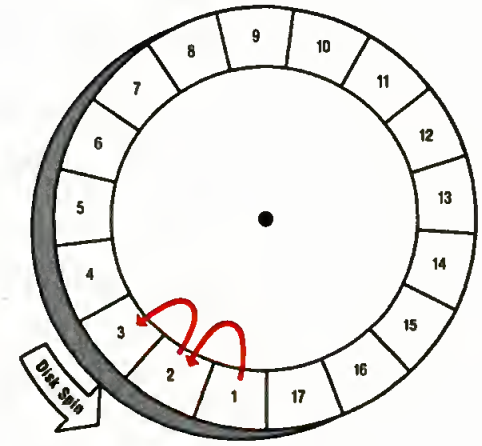
### 6-to-1 Interleave

With a 6-to-1 interleave (the interleave factor thet IBM adopted for the PC-XT), the read/write head must skip five sectors between consecutive reads or writes, slowing down data I/O.




### 1-to-1 Interleave

With a 1-to-1 interleave, sectors are adjacent on the disk and the read/write head can move between them smoothly and swiftly. The Sysgen Matched Pair and TG-5525i speed up data I/O by eliminating sector interleave in this way.




**WEAVING SECTORS** Sysgen and Tallgrass Technologies Corp. are two companies that effectively have been working magic on the format used for storing data on disk by doing away with sector interleaving.

In the official IBM scheme of things, disk sectors are not read one after another in the order that they are found on the disk. Instead, after one sector is written, five physical sectors (those on the disk) on the track are skipped before the next sector is written. The hard disk controller in the PC sorts out the shuffled sectors and sends them to DOS as logical sectors that are written and read as smoothly as if they were adjacent.

Although DOS is isolated from this sector interleaving, its physical consequences unfortunately result in a speed penalty. For every six sectors that the disk moves, only one sector is written or read. This means that writing or reading a whole track, ordinarily made up of 17 sectors, requires five spins of the disk. Because each complete turn of the disk requires $^1/_{60}$ of a second (the spin speed of hard disks is about 3,600 revolutions per minute), gleaning a full track takes 8.33 milliseconds, or about $^1/_{12}$ of a second. (Most people believe that IBM originally adopted the interleave factor of 6 to 1 chiefly to slow down the speed at which data comes from disk to match the rate at which the 8088 microprocessor could absorb it.)

Both Sysgen and Tallgrass eliminate sector interleaving, though the sector arrangement is often described as having an interleave of 1 to 1 or, simply, 1. In the Sysgen Matched Pair system (the matched pair here is an internal hard disk and controller board), each logical sector lies adjacent to the next one to be read, and all the logical sectors on a track are contiguous. The Tallgrass TG-5525i, an internal hard disk, doesn't even slice the track into sectors. It records the whole track as a single block of data, and the Tallgrass disk controller then divides it into sector-size chunks electronically so that DOS doesn't know the difference. Both the Sysgen and the Tallgrass systems write or read a whole track in a single spin of the disk—a theoretical speed advantage of 500 percent over an ordinary XT disk.

The motivation behind the whole-track-at-a-time trick is different for each system. Sysgen adopted the 1-to-1 interleave purely to improve its hard disk's performance. Tallgrass uses it because it also better

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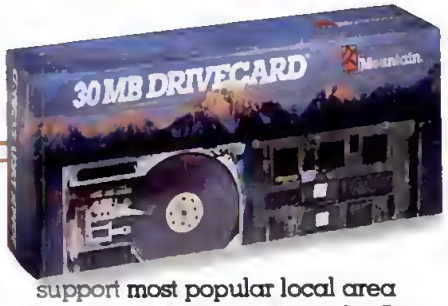


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matches its unique (in the PC hard disk world) disk data structure.

**INTERLEAVING IMPEDIMENTS** The sector interleave of a disk is determined at the time the low-level format is applied to the disk. Low-level formatting (which should not be confused with the DOS formatting process that merely imposes a logical structure on an already formatted disk) writes sector identification and timing information on a blank disk. The actual interleave factor that's used is virtually invisible to you and your software because your hard disk controller isolates the rest of the computer system from on-disk data-structure concerns.

But you are likely to notice a difference in the speed of data transfer. In theory, a lower interleave is supposed to give higher performance; therefore a 1-to-1 interleave should be the fastest-performing sector arrangement for a hard disk.

Reality is somewhat different. A hard disk's read/write head cannot move instantly between adjacent tracks or cylinders of the disk. The track-to-track access time of most hard disks is in the vicinity of 5 to 10 milliseconds—about the time it takes the disk to spin halfway around. Thus, with straight 1-to-1 interleaving, when the read/write head finishes with one track, it has to wait for the next revolution before it can start writing or reading the next track.

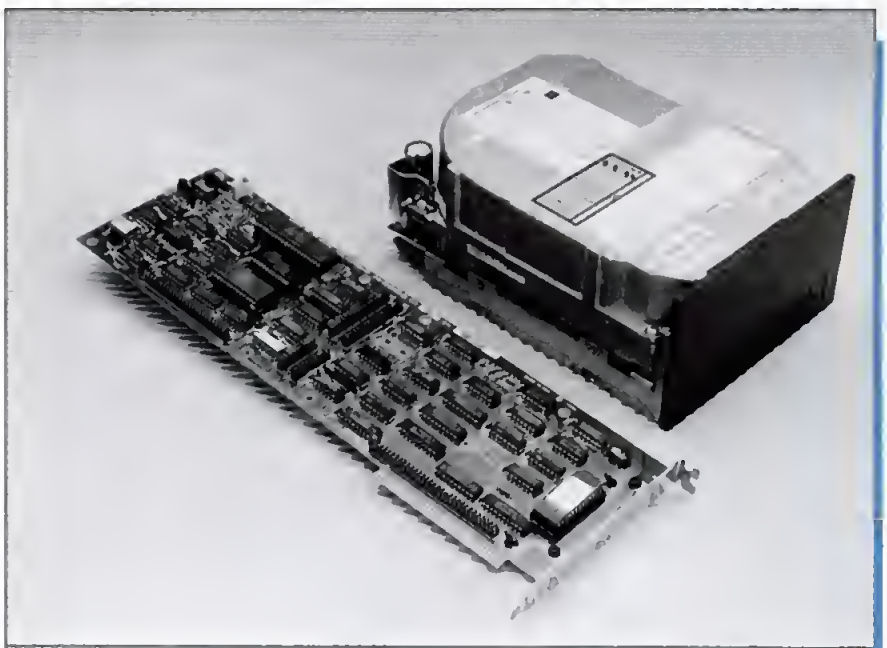
The Sysgen Matched Pair system works around this problem by including a full-track buffer in its controller circuitry. Whenever a request is made to read a sector from the Sysgen hard disk, the controller automatically reads the whole track which contains that sector and stores the full track of data in its buffer memory while it is sending the data from the requested sector to its host computer. In most applications, where one data cluster—usually four sectors—is read at a time (with a pause for processing before going on to the next cluster), reading the full track imposes no performance penalty. Performance does suffer, however, when you're randomly reading or writing short records.

Computers based on the 8088 microprocessor supposedly are not fast enough to absorb all the data in a full track as it is being read from the disk, so the disk is effectively idle while the track information is being transferred from buffer to host. During these idle periods, the Sysgen controller keeps monitoring sector requests. When data is needed from a sector written on another track, it moves the read/write head to that track while data is still being dumped from the buffer. By the time the host computer has digested everything from the first track, the Sysgen disk is reading the next, pumping out information continually.

■ The TG-5525i hard disk doesn't have a 1-to-1 interleave factor, but it acts as if it does.

To improve performance still further, the Sysgen Matched Pair links the company's full-length controller card to a Toshiba 70-megabyte hard disk, which features an average access time of about 30 milliseconds (a 40-megabyte model is also available). The controller, which uses the standard 5-MHz ST506 interface and MFM (modified frequency modulation) recording, has a built-in low-level format program that will accommodate a number of other drives. (MFM is the recording system used on most currently available hard disks; see sidebar "Faster, Denser Disks with RLL.") Sysgen also supplies software to partition the large drive into several volumes, each of which acts like a separate logical disk drive. The system is compatible with most XT-like machines that have adequate power—at least 130 watts.

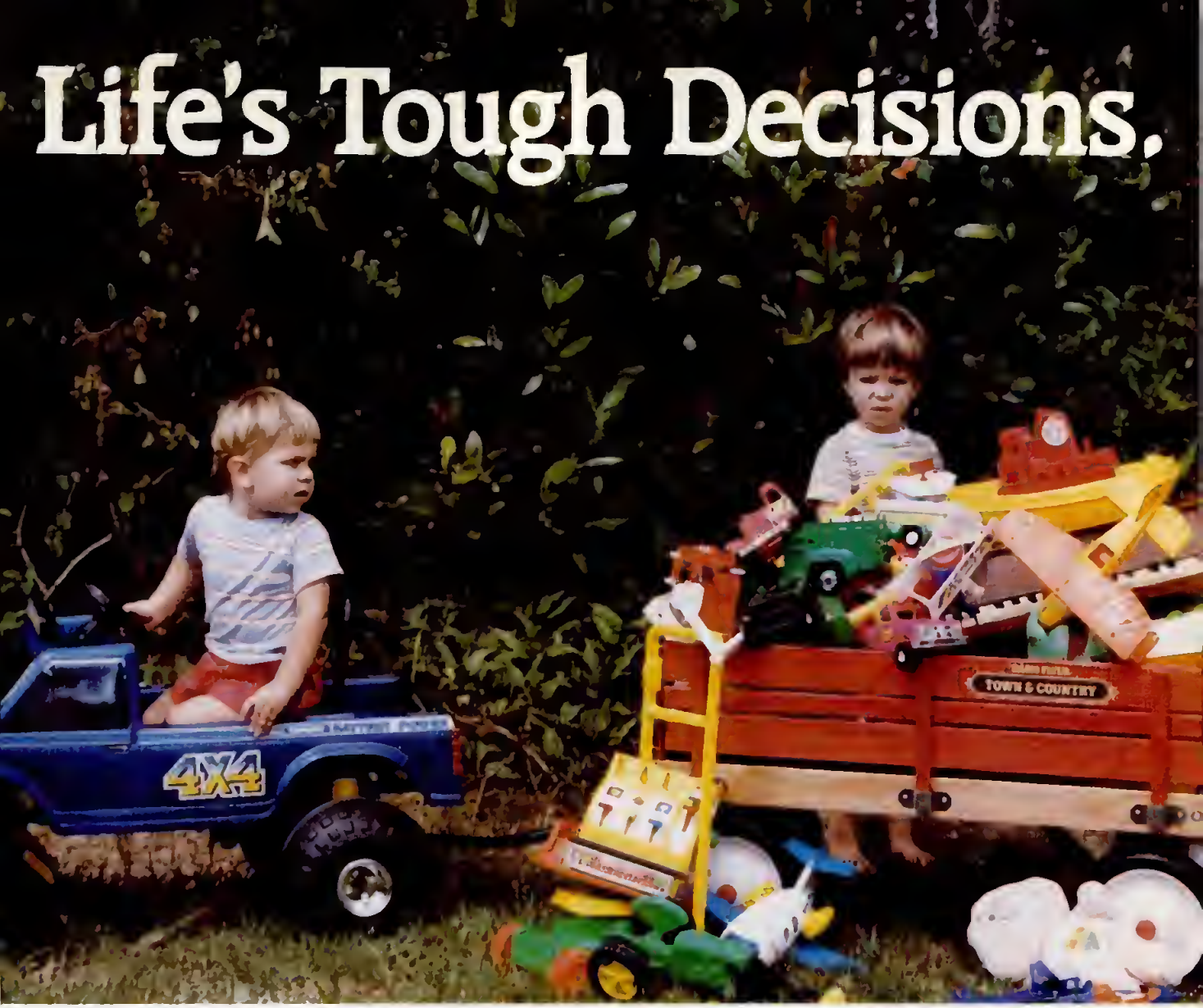
**DATA GROUPS** The Tallgrass TG-5525i hard disk doesn't actually have a 1-to-1 interleave factor, but it acts as if it does, reading and writing full tracks of data in sequence. The novel Tallgrass arangement, which relies on group-coded recording (GCR), was a design choice based primarily on the desire to operate a hard disk and a tape backup unit with the same controller electronics. Besides achieving tape and disk compatibility



*The Sysgen Matched Pair system eliminates sector interleaving to improve performance and links the company's full-length controller card to a Toshiba 70-megabyte hard disk.*

Photographs: Thom O'Connor

# Life's Tough Decisions.

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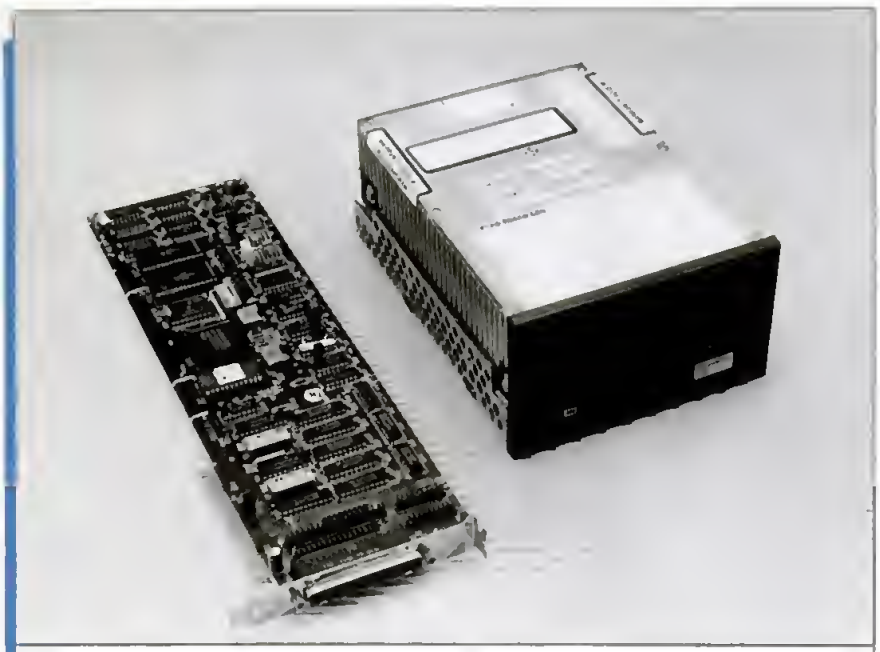

*The Tallgrass TG-5525i is an easily installed internal hard disk that increases capacity by storing a whole track as a single long block of information.*

along with the economy of using a single controller for two systems, Tallgrass gains greater disk storage capacity by storing a whole track as a single long block of information, with no sector divisions. Since the elimination of sectoring saves the disk space normally reserved for sector identification information, GCR further increases the density of data on the disk. Thus the 20-megabyte Control Data Corp. hard disk in the Tallgrass TG-5525i tested actually held 26 megabytes.

In order to maintain compatibility with DOS, the Tallgrass controller—a full-length expansion card—acts as an interpreter, breaking the big block into DOS-sized sector-like chunks and sending the appropriate chunk to the system when it is needed.

In truth, we found that the standard XT drive outperformed the Tallgrass in two out of three tests. The TG-5525i's principal liability is the system's absolute need to read and sort through a whole track even when only a single sector of data is requested. This penalty is especially great when DOS randomly accesses small records, as it often does. The Tallgrass TG-5525i has a greater speed potential when combined with non-DOS operating systems that typically use longer records.

■ A new data coding scheme called run length limited (RLL) promises to improve disk I/O and increase disk capacity—by as much as 50 percent.

The TG-5525i is as easy to install as any other disk system and can replace the hard disk in an XT or any PC-compatible computer that has at least 130 watts of power. Tallgrass includes its excellent *BackTrack* program, which automatically makes tape or disk backups while you work.

**RUN LENGTH LIMITED** A new data coding scheme called run length limited (RLL) also promises to improve disk I/O and increase disk capacity—by as much as 50 percent.

Because RLL, like GCR, is simply a scheme for rearranging bit patterns of encoded information on disk, its speed and capacity increases are won without any change to the hard disk itself. A disk that nominally is able to store 20 megabytes using the older MFM coding can effectively hold 30 megabytes using the RLL coding scheme.

The RLL coding scheme is new only to personal computers. Originally developed by IBM for mainframe-style mass-storage systems, RLL has been a well-established technology in larger computer systems for a number of years. However, the technology has not been widely used in personal computers because of difficulties encountered in implementing it with earlier controller hardware. Compared to MFM, RLL requires circuitry that's inherently more complex and, at least initially, more expensive.

The first company to make RLL work with PCs was Sunol Systems, which in 1984 introduced a network hard disk with a massive proprietary RLL controller card that was several times larger than an ordinary PC expansion card. Other companies quickly followed suit, compressing the RLL circuitry into custom VLSI (very large scale integration) chips. When Plus Development Corp. introduced its HardCard last year, RLL was the key to packing a full 10 megabytes inside the miniaturized expansion-slot-sized hard disk. However, the HardCard used a special interface that is not compatible with most of the hard disks on the market.

**COMPETING CARDS** Earlier this year, two prominent disk controller manufacturers, Adaptec and Scientific Micro Systems, introduced RLL controllers for the standard ST506 disk interface. Nearly every other disk controller maker is working on or has announced a similar line of RLL products.

Like the standard IBM hard disk controller in the XT, the Adaptec ACB-2070A RLL controller (see First Looks, *PC Magazine*, Volume 5 Number 16) requires one full expansion slot and is able to control two hard disks. A low-level formatting program built into the on-board ROM of

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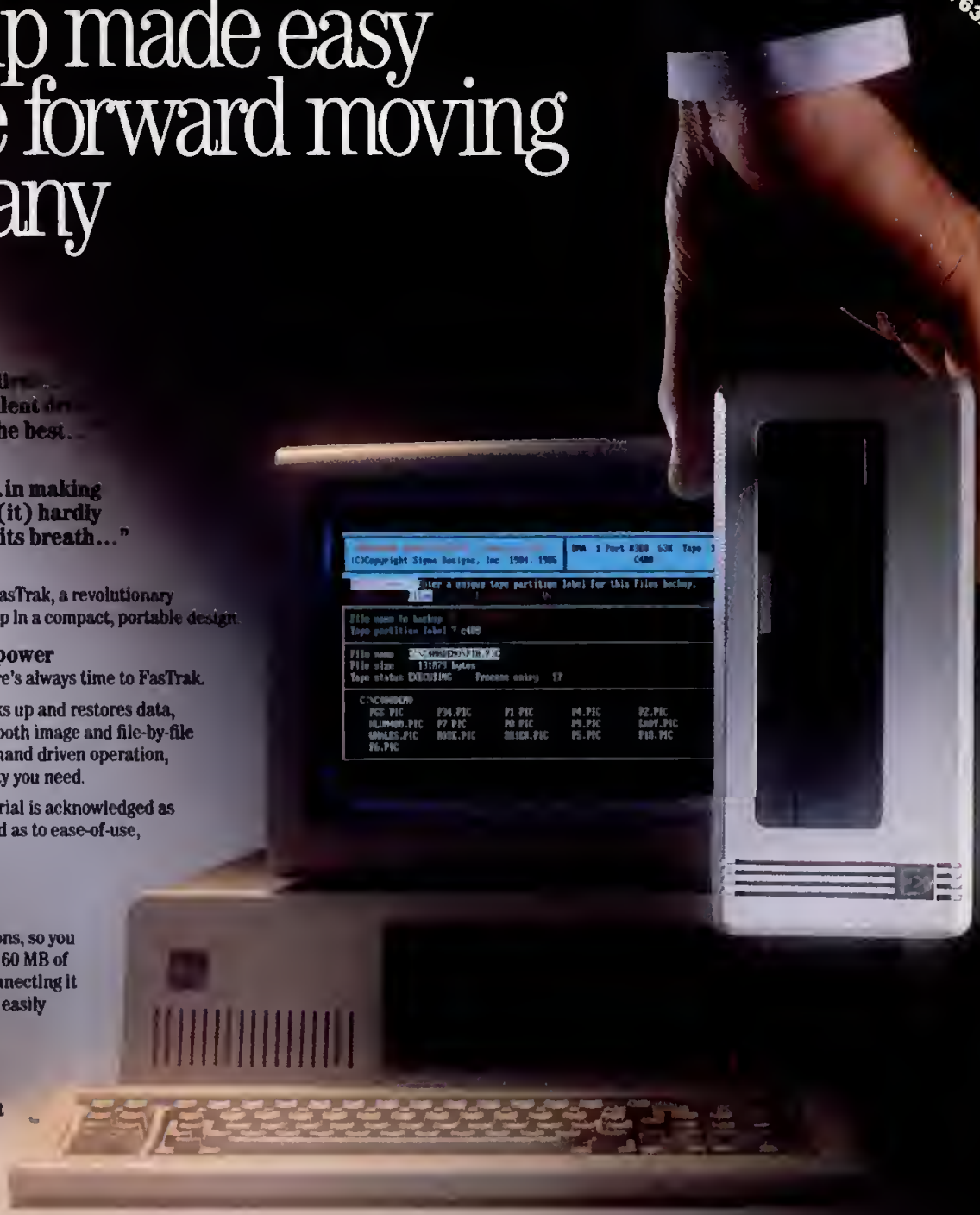

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Squeezing more data into a given amount of disk space might seem like magic, but with run-length-limited (RLL) technology, it's simply a matter of mathematics.

Information is stored on hard disks in the form of magnetic flux changes—reversals of the magnetic field in the small particles of oxide or thin-film medium that covers the platter of the hard disk.

The electronic circuitry of the disk controller translates the bit patterns of the data sent from the host computer into the new patterns that will become the flux changes that are written on the disk. In the most rudimentary form, for instance, each data bit might be translated into a single flux change.

The characteristics of the magnetic medium, the speed at which the disk spins, and the design of the disk read/write head together determine the minimum and maximum spacing of the flux changes on the disk. If the flux changes are too close together, the read/write head might not be able to distinguish between them; too far apart, and they cannot be reliably detected.

In one of the earliest magnetic digital recording schemes—called frequency modulation, or FM recording—the disk controller added an extra bit, called a clock bit, ahead of each data bit written on the disk. When read back, each clock bit signaled to the controller that a data bit would follow. The presence of a flux change between two clock bits indicated a digital 1, and no flux change between clocks indicated a digital 0. The possible spacing of flux changes was thus confined to a very narrow range of two values, but two flux changes were needed to record each bit of data.

Modified frequency modulation recording (MFM), the system used in most contemporary PC disks, does not use clock bits. It stores digital 1s as a flux transisition and 0s as the lack of a transition within a given period. To prevent flux reversals from occurring too far apart, an extra flux reversal is added between consecutive 0s. Because no flux reversals are needed to represent clock bits here, MFM packs information twice as densely on disk. Hence MFM is sometimes called double-density storage.

RLL is much more complex. It translates the incoming binary code into its own, different digital code of 1s and 0s, which it sends to the disk. This translation occurs not at the bit level but one step higher: each incoming byte is assigned a new code pattern 16 bits long.

Only a fraction of the available 16-bit patterns—the ones that are easiest to record magnetically—are used. The principal requirement is that there must be from two to seven 0s between each 1 (hence, the formal name of the system used by both Adaptec and Scientific Micro Systems—2,7 RLL). The remaining 16-bit code patterns are made illegal and never appear in the final output to the disk drive.

Although the coding scheme requires twice as many bits to encode its data, it fits better within the limits of the recording medium and allows data bits to be coded to flux changes three times as dense. Only the 1s cause flux changes, and they are always spaced at least three binary places apart. Hence, although there are twice as many code bits, they can be three times closer together and still keep the same spacing of flux changes as would be produced by MFM. The gain in storage density over MFM is thus 50 percent.

In both the Adaptec and Scientific Micro Systems arrangements, the added information is packaged into additional disk sectors on each track. Instead of the DOS standard of 17 sectors per track, both controllers create 25. And because the disk spins at the same speed no matter what data code system is being used, the 25 sectors of RLL are transferred to the controller in the same amount of time that MFM takes to move 17.

The penalty that RLL's greater recording density imposes is that it requires a much more complex controller and better-quality disk drives capable of handling higher data rates. Not all hard disk drives can reliably transfer information at the RLL rate—7.5 MHz—although more and more such drives are becoming available.—**Winn L. Rosch**

the ACB-2070A allows you to set both the hard disk interleave (which may be anywhere between 3 to 1 and 16 to 1) and the seek-step pulse rate, which controls the speed of read/write head movement.

The Scientific Micro Systems OMTI 5527 disk controller is part of the company's OMTI line of highly integrated PC-compatible disk controllers. The OMTI 5527 card is remarkable for its miniaturization: it's just 5 inches long and fits easily into an XT short slot. All of the necessary logic for RLL recording is contained in several custom VLSI chips on the card.

■ The OMTI 5527 card is remarkable for its miniaturization: it's 5 inches long and fits easily into an XT short slot.

Also, like most of the new hard disk controllers, the OMTI 5527 will operate two hard disks.

Probably the best part of the 5527 is the OMTI software available from SMS. It allows ordinary human beings—as distinguished from assembly language programmers—to match nearly any disk drive to the XT. The disk includes several *OMTIdisk* programs for setting up multiple DOS partitions and drivers for dividing large disks into a number of virtual volumes.

The *OMTIdisk* software will low-level-format nearly any hard disk drive. By writ-

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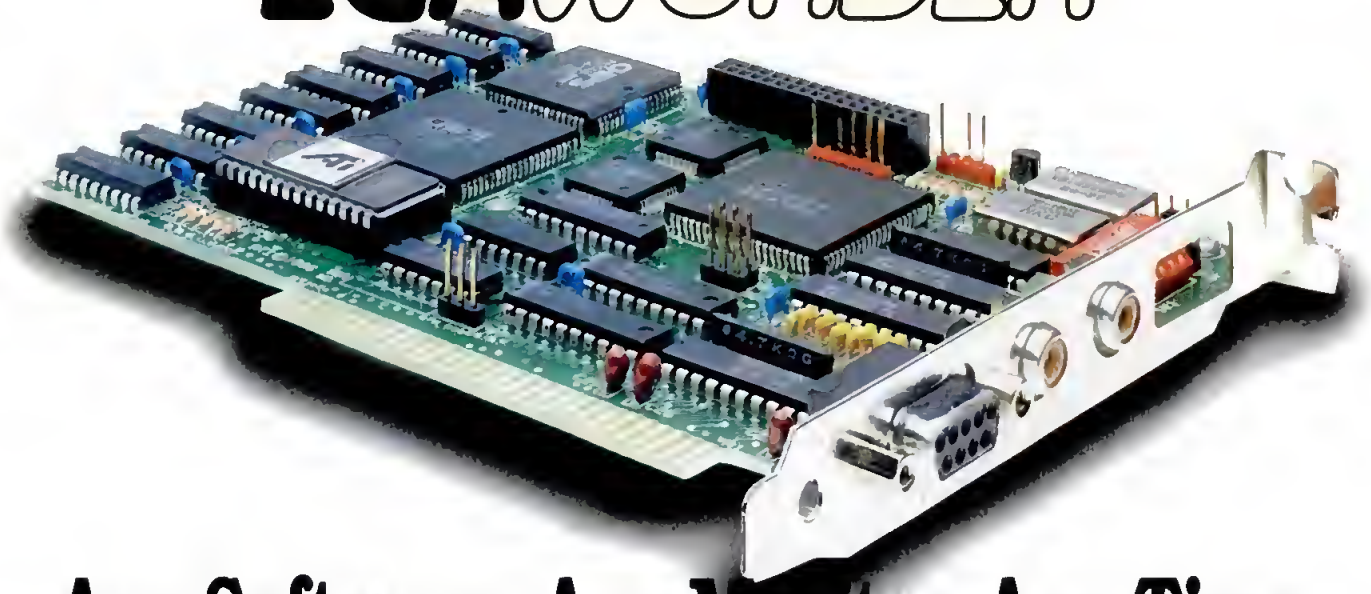

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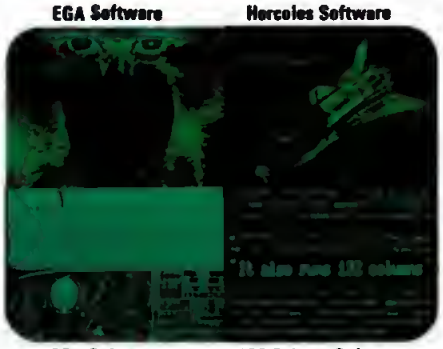


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| Features | ATI EGA Wonder | Paradise Auto Switch | Quadram and Video 7 |
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| Compatible to EGA, CGA, MDA, Hercules | ✔ | ✔ | ✔ |
| 256K Video Memory | ✔ | ✔ | ✔ |
| Automatic Switching Between EGA and CGA Color Modes and Among EGA, MDA, and Hercules Modes | ✔ | ✔ | |
| Runs EGA, CGA, MDA, Hercules and 132 Columns on an EGA Monitor | ✔ | | |
| Runs EGA, CGA, MDA, Hercules and 132 Columns on an RGB Color Monitor | ✔ | | |
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| Suggested List Price | $399 | $505 | $599 |

EGA – Enhanced Graphics Adapter MDA – Monochrome Display Adapter
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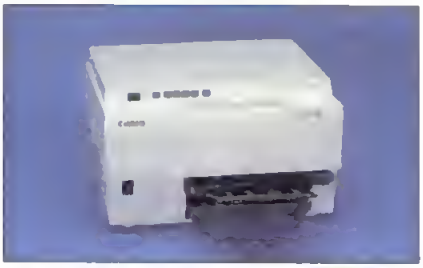

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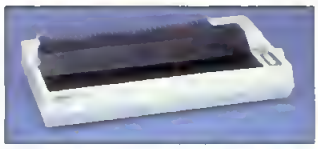

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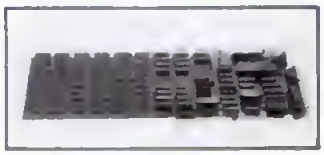

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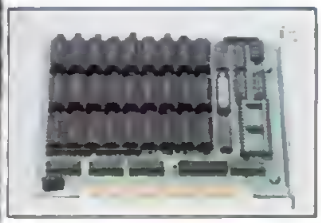

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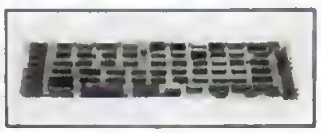

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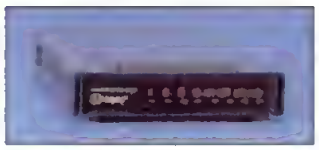

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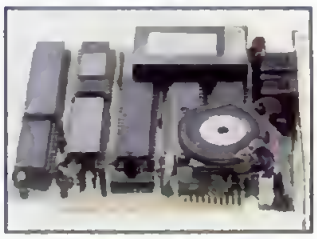
Logic (Hayes Comp.) 2400 Baud External Modem .. 309



Logic (Hayes Comp.) 1200B Internal Modem with Mirror (Crosstalk Clone) Software ..... 149
Logic 2400B Internal Modem 2400B w/Software ..... 299

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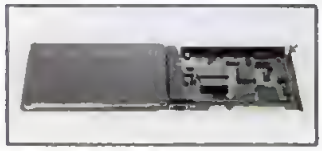

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20 Mb Int ..... 595
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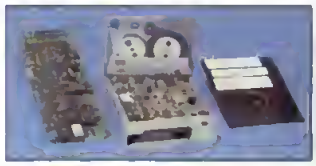

Logic 60 Mb Internal Cartridge Tape Backup Kit ..... 725
Logic 20 Mb Internal Cartridge Tape Backup Kit ..... 569

**SYSGEN**
Image Tape Backup 10 Mb Int ..... 789
Image Tape Backup 20 Mb Int ..... 599
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**TECMAR**
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**CORE**
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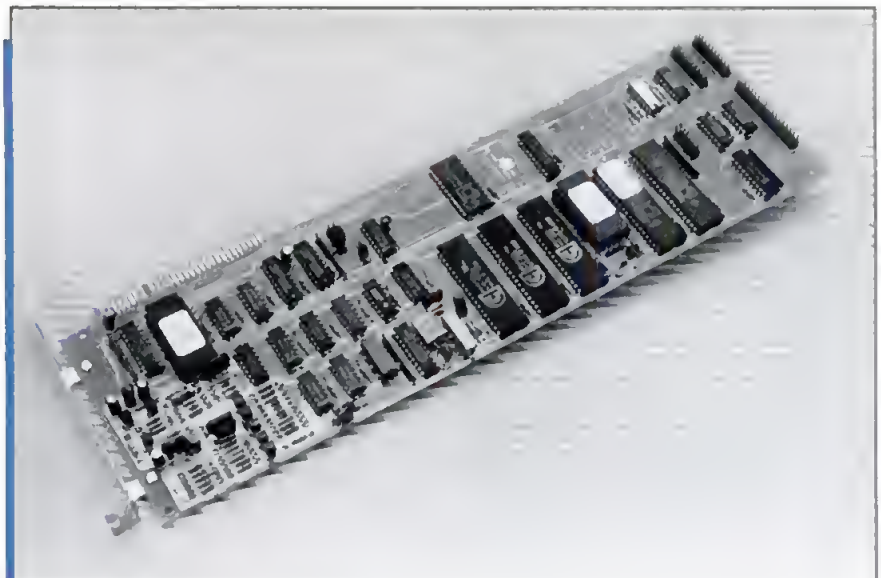

*The Adaptec ACB-2070A RLL controller improves performance by letting you set the hard disk interleave and the seek-step pulse rate. You con experiment to find the best combination.*

*The OMTI software from Scientific Micro Systems ollows you to match neorly ony disk drive to the SMS 5527 controller. The disk includes programs to set up multiple DOS partitions.*

ing certain drive identification information on a disk track during this process, it enables the OMTI 5527 controller to recognize nearly any arrangement of disk platters, heads, and other hardware parameters. In addition, it allows you to set any sector interleave on the hard disk between 1 to 1 and 16 to 1.

Currently, the price premium for either of these RLL controllers amounts to only a few dollars over the cost of an ordinary MFM controller card. They are already becoming popular with suppliers of disk subsystems because they allow a 20-megabyte system to hold 30 megabytes with only a tiny increase in cost.

Although at $169 an RLL controller might seem like a quick and easy way to increase the storage capacity of your XT and, at the same time, speed up its performance, you cannot just take your old controller out and slide a new one in. RLL makes more-stringent quality demands on disk drives than do older encoding methods like MFM. The standard drives that IBM installs in PC-XTs just can't handle RLL reliably. Taking advantage of RLL thus requires a radical change: replacing the XT hard disk entirely, or adding one to a floppy-based system.

■ The standard drives that IBM installs in PC-XTs just can't handle RLL reliably.

**DATA ACCESS** If your primary aim is to get the most performance possible from your personal computer, in addition to looking for a hard disk drive that is capable of handling RLL recording, you should really hold out for a drive with a better average access time because it can move its head between random tracks on the disk much faster.

Core International has probably done more than any other company to draw attention to the data access speeds of hard disks. Its focus has been average access time, a measure of how quickly any record can be found at random on the disk. While all the publicity has focused on increasing AT hard disk speeds, Core has also introduced XT-compatible disks with similar, lightninglike access speeds. The Core International XT20 and XT43 (with capacities of 20 and 43 megabytes, respectively) are two representatives of the company's ATplus line, which extends to 72-megabyte drives.

The primary limit on access time is the

*Core International's XT20 (left) and XT43 (right) are XT-compatible disks that have outstanding access speeds and 20- and 43-megabyte capacities, respectively.*

disk drive itself and is specifically related to two variables: the technology used in the mechanism that moves the head across the surface of the hard disk platters and the physical construction of the head and related mechanism.

The average access time of the hard disk supplied with 8088-based XTs measures about 85 milliseconds. Some of the drives that came with older XTs are even slower. In contrast, the latest Core drives for the XT turn in average access times of about 20 milliseconds. Installing one in an XT should appreciably improve its data retrieval speed, as well as increase mass storage capacity.

With drives that are not compatible with standard XT-style hard disk controllers, Core also supplies a controller. (The old IBM controller can only handle drives up to 10 megabytes; the newer IBM controller could handle the Core XT20 but not the XT43.) The Core controller can further improve performance because it uses short

## PC MAGAZINE FACT FILE

**Adaptec ACB-2070A**
Adaptec Inc.
580 Cottonwood Dr.
Milpitas, CA 95035
(408) 946-8600
**List Price:** $154
**Requires:** RLL-compatible hard disk, DOS 2.0 or later.
**In Short:** A controller board that speeds up the attached hard disk and uses RLL to pack in 50 percent more data.
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**Core International XT20 and XT43**
Core International
7171 N. Federal Hwy.
Boca Raton, FL 33431
(305) 997-6055
**List Price:** XT20, $1,395; XT43, $1,695.
**Requires:** DOS 2.0 or later.
**In Short:** High-speed XT drives with average access times of about 20 milliseconds.
CIRCLE 686 ON READER SERVICE CARD

**Scientific Micro Systems OMTI 5527**
Scientific Micro Systems Inc.
339 N. Bernardo Ave.
Mountain View, CA 94043
(415) 964-5700
**List Price:** $169
**Requires:** RLL-compatible hard disk, DOS 2.0 or later.
**In Short:** A controller board that speeds up the attached hard disk and squeezes in 50 percent more data using RLL technology.
CIRCLE 689 ON READER SERVICE CARD

**Sysgen Matched Pair**
Sysgen Inc.
47853 Warm Springs
Fremont, CA 94539
(800) 821-2151
(415) 490-6770
**List Price:** 40-megabyte hard disk, $1,795; 70-megabyte hard disk, $2,995.
**Requires:** DOS 3.0 or later.
**In Short:** An internal hard disk with increased speed due to its 1-to-1 interleave factor and intelligent full-track buffering.
CIRCLE 690 ON READER SERVICE CARD

**TG-5525i**
Tallgrass Technologies Corp.
11100 W. 82nd St.
Overland Park, KS 66214
(913) 492-6002
**List Price:** $1,195
**Requires:** DOS 2.0 or later: Tallgrass software requires 256K RAM.
**In Short:** An internal hard disk with increased capacity because of its GCR recording technique and sectorless format.
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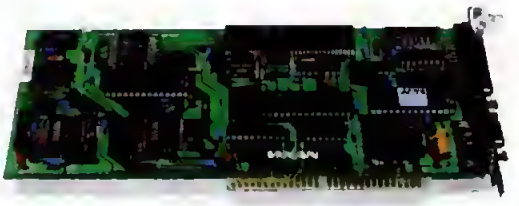

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seek-step rates that the Core drives can take advantage of, while standard IBM drives cannot.

**REAL-WORLD DIFFERENCES** A prevalent belief in the PC community is that the speed handicaps were built into the XT hard disk system because the XT itself is not able to handle disk data any faster than it does in its standard configuration. Any improvement in hard disk performance in an 8088-based system would be negated by the laggardly microprocessor's inherently limited data-processing abilities.

Contrary to this notion, new drive and controller technology can improve real-world performance substantially—although perhaps not as dramatically as some of the manufacturers claim.

PC Labs tested four influences on XT disk performance: sector interleave, data encoding method (in particular, modified frequency modulation versus run length limited), full-track buffering, and average access time. We based our comparisons on special benchmark test programs, written in assembler, that sequentially wrote and read one very large file and randomly read the records of that file.

**PC MAGAZINE EDITOR'S CHOICE**

*The degree to which you can improve your XT's hard-disk performance depends on how much money and time you're willing to invest. For a straightforward, time-efficient approach, we'd choose the* ***Sysgen Matched Pair*** *for its high level of all-around performance on the PC Labs tests and its relatively easy installation.*

*Were we to take the time to tinker, we'd combine a high-speed Core drive with the Scientific Micro Systems OMTI 5527 disk controller and set the interleave as low as we felt safe. If we didn't want to experiment and find the number of DOS buffers that gives the best performance with our software, we'd set them at 20 and be content with knowing that our disk system was running up to three times faster than the one in an ordinary XT.*

**SPEED IMPROVEMENT** Reducing the sector interleave will speed disk performance even on a personal computer as processor-bound as an IBM PC-XT. We measured the effects of different sector interleave factors using the SMS OMTI 5527 disk controller and formatting disks with *OMTIdisk* software. On the Core XT20, we achieved across-the-board speed improvements of 10 to 40 percent by optimizing the sector interleave and the specified number of buffers. Reducing the interleave from the IBM XT standard of 6 to 1 to the often-recommended 3-to-1 ratio gave the biggest performance boost. We expected to achieve the optimal results at a 2-to-1 interleave, but the fastest performance was measured at a 1-to-1 interleave even without full-track buffering.

**BUFFER POWER** Sector buffering proved to be a much larger factor in determining disk data-handling performance. With every disk drive tested, increasing the number of buffers specified in the test system's CONFIG.SYS file from the DOS default value of 2 to 3 improved performance dramatically. Overall performance increased marginally through 20 buffers.

# BUFFERING HARD DISK DATA

One of the most valuable inferences you can draw from PC Labs' extensive testing of new hard disk technology concerns the importance of taking advantage of a performance booster that's built into DOS.

The BUFFERS command tells DOS how much RAM to reserve for keeping disk information in memory. Every time DOS reads the disk, it gathers up the amount of information specified by the BUFFERS command, even if only part of that data was requested. DOS holds the rest of the data in memory just in case you or your program need it later. If you do request something that DOS has filed in memory, DOS doesn't have to waste time reading the disk: it just recites what it remembers. Because reading from memory is much faster than reading from disk, the buffered data can be accessed much more quickly—in microseconds instead of milliseconds.

Similarly, when writing to disk, DOS holds data in its buffers and doesn't actually write it until the buffers fill up or until you formally close the disk file.

You specify the amount of memory to set aside for this purpose in your CONFIG.SYS file, which DOS reads as it boots up your system. The command takes the form

BUFFERS = *xx*

where *xx*, a number between 1 and 99, is the amount of memory you want DOS to use for buffering, given in blocks of roughly 512 bytes (corresponding to one disk sector). If you do not put a BUFFERS command in your system's CONFIG.SYS file or you have no CONFIG.SYS file at all, DOS assumes a value of 3.

Don't go overboard when specifying buffers: using too much memory for buffering can slow down your system when a program tries to read a large number of short, scattered records. In that case, DOS must read a large block of information from disk when it needs only a little.

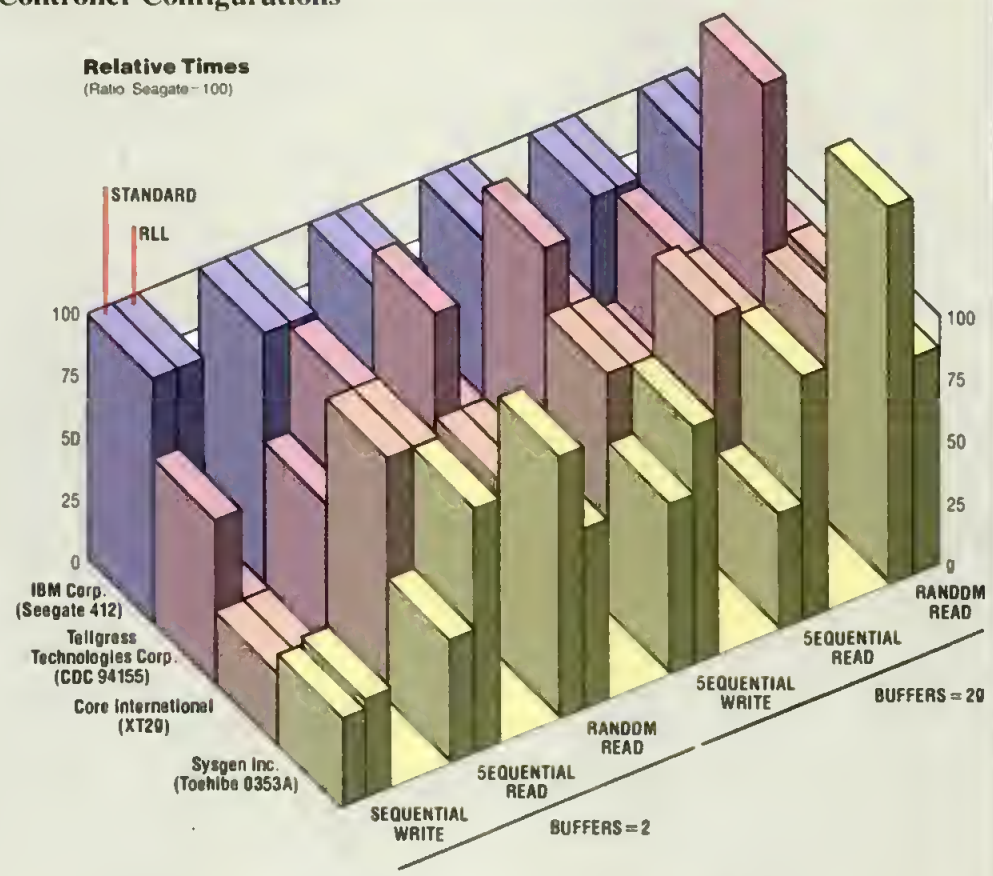
There is substantial debate surrounding the proper number of buffers to specify. Two safe assumptions are that 3 are too few and 99 too many. A good compromise is 20.

The best number to use depends on the applications you run. If your favorite programs consistently read and write large blocks of data, you should use a large number of buffers. If your applications read and write many short records at random, a small number will work better for you.—**Winn L. Rosch**

## Benchmark Test: Hard Disk Drive/Controller Configurations

The differences in drive performance are most notable under a default buffer value of 2. The Core XT20 appears wantonly fast, besting the standard IBM drive by nearly 70 percent when doing sequential writes. However, sector buffering smoothes the gap down to a "mere" 54 percent for the Sysgen drive during sequential reads. Considering the abject lack of speed built into the Seagate hard disk supplied with the PC-XT, RLL encoding combined with sector buffering makes that drive perform like a hyperdrive, dropping overall differences into the 2 to 15 percent level.

Results were also obtained for two intervening buffer levels, 3 and 10. Both levels favored sequential file operations (a 60 percent improvement over default was typical) over random access (less than 3 percent improvement). At BUFFERS = 20, sequential operations were approximately 5 percent slower than at their optimum times while random access showed a 15 percent (or greater) improvement. All tests were conducted with an interleave factor of 6.




| | Default setting: BUFFERS = 2 | | | | | | BUFFERS = 20 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sequential Write | | Sequential Read | | Random Read | | Sequential Write | | Sequential Read | | Random Read | |
| Company (Drive model) | (Standard) | (RLL) | (Standard) | (RLL) | (Standard) | (RLL) | (Standard) | (RLL) | (Standard) | (RLL) | (Standard) | (RLL) |
| IBM Corp. (Seagate ST-412) | 988 68 | 881 29 | 223.12 | 177.07 | 472 44 | 448 57 | 190 09 | 138 81 | 241.27 | 196 46 | 306 97 | 285 55 |
| Tallgrass Technologies Corp. (CDC 94155) | 667 24 | 322.22 | 123 08 | 171 29 | 527 86 | 302.25 | 225 52 | 130 20 | 127 04 | 191 79 | 452 60 | 243.17 |
| Core International (XT20) | 286 30 | 318 11 | 218 60 | 171.97 | 324.00 | 314 40 | 180 13 | 130 77 | 238.54 | 192 45 | 255 64 | 249 66 |
| Sysgen Inc. (Toshiba 0353A) | 365.23 | 365 05 | 111.47 | 172 28 | 493.19 | 313 91 | 128 23 | 130 99 | 110 72 | 191.18 | 448 36 | 248 39 |

The **Herd Disk Drive/Controller Configurations** benchmark test measures the speed advantage gained over standard drive/controller configurations when RLL technology is combined with buffers of various sizes. The test comprises writing a 10-megabyte ASCII file sequentially to disk and reading it back again, first sequentially and then randomly. The standard controller results were achieved by connecting each hard disk to an IBM PC-XT test "mule" via the controller card and special driver software that is ordinarily supplied by the drive manufacturer. An exception to this procedure was the Core International XT20. Because it was shipped with a controller card set up for a larger capacity hard disk and because a replacement was not available in time, the tests were run using the standard IBM Xebec controller. With its own controller card installed, the Core drive might very well have reported faster results on the standard-configuration part of the test. In the case of the IBM PC-XT, the standard drive is the Seagate ST-412. Tallgrass Technologies' drive/controller combination, the TG-5525i, uses a CDC 94155 drive and its own controller. The Sysgen Matched Pair incorporates the Toshiba 0353A drive.

All of the RLL tests were performed with the same Scientific MicroSystems DMTI 5527 RLL controller. As the text indicates, the typical IBM PC-XT hard disk (a Seagate ST-412 in this case) is not RLL compatible. To obtain comperative results for the IBM drive/controller configuration using RLL, PC Labs decided on some sleight of hand to trick the drive and used *OMTIDisk* software to reserve a cylinder for error mapping. The loss of a cylinder ordinarily means 35K less data storage, but with RLL, the aggregate storage capacity of the Seagate drive (originally 10 megabytes) rose to just over 15 megabytes. All other drives were formatted (low and high levels) via the standard IBM Diagnostics disk, DOS FDISK, and FORMAT commands. In all RLL cases, the partition size was restricted to 305 cylinders to match the ST-412, even though this technique is extremely wasteful. All drives were formatted to the maximum possible storage area.

# ACQUIRING A HARD DISK CONTROLLER

Although hard disk controllers look just like any other PC expansion cards, they tend to be hard to find. Most computer dealers won't sell them because in the past they have been more difficult to install than any other PC peripheral, and, consequently, there was no demand for naked controllers.

At one time, the complexity involved in getting a controller/hard disk combination to work made this situation practical. If you were an assembly language programmer with a PROM burner for making your own firmware chips, you could write a special program that matched a given model of disk to the controller and make it into a memory chip compatible with the rest of your PC system. In the past, only system integrators and a few mail order vendors could afford to buy or write the code needed to make any specific controller/hard disk system work straight out of the box.

The Adaptec and Scientific Micro Systems cards simplify the matter of installing a disk controller. They record all the setup information needed to operate the disk on the disk itself, and they automatically retrieve it when they need it. Software is available—either built into the controller card itself (Adaptec) or as an optional disk (Scientific Micro Systems)—that allows almost anyone to record this information at the time the disk is first low-level-formatted. If you have a little technical knowledge, you can probably match one of these new controllers to your own hard disk. (If you opt for the Scientific Micro Systems controller, be sure to buy the *OMTIdisk* software.)

While many computer dealers still won't sell controllers without disk drives, you should be able to buy these advanced controller cards at some of the same places the dealers do.

Adaptec reports that its products are available through three large distributors: Wyle Laboratories in the Western United States; Pioneer Standard Electronics in the East; and Hamilton/Avnet nationwide. These distributors have branches in most large cities, and you can usually place telephone orders with them.

**—Winn L. Rosch**


# The Canon Bubble-Jet Printer is very compatible with all these units.

The difference was apparent in both random and sequential access tests, with the biggest differences appearing when we ran relatively slow disk drives. In fact, for sequential disk access, buffering proved to be the great equalizer.

The intelligent full-track buffering and 1-to-1 interleave of the Sysgen Matched Pair gave it a tiny performance edge over the other systems in reading sequential files. However, in sequential writing and random disk access, the Core drive with a low interleave outperformed the Sysgen system.

The most surprising factor in the tests was RLL. The 30 percent faster data transfer rate achieved by the denser data-coding scheme did in fact substantially speed up data transfers, notwithstanding the XT's pokey processing. We formatted the standard IBM PC-XT hard disk drive using RLL even though this drive is not recommended for RLL applications. The speed difference—almost 20 percent—was most apparent when relatively few DOS buffers were specified, but it still amounted to 10 percent in both the sequential and random access modes with 20 sectors of DOS buffering.

■ The PC Labs test results show that no one system or technology will be the fastest in every possible application.

The PC Labs test results show that no one system or technology will be the fastest in every possible application. Even increasing the number of DOS buffers proved to have its drawbacks. For instance, while increasing the number of DOS buffers improved most results, it actually slowed down the sequential reading of the 10K-byte test records. With shorter records, the adverse effects of increased buffering would have been even more dramatic.

Even with the latest technologies, optimizing hard disk performance remains something of an art. Getting the most from your system is going to require some experimentation with applications software and the hardware that you already have. As is the case with any art, however, you'll have more to work with when you use better tools. RLL data coding, full-track buffering, and fast-access disk drives will help give you better performance. PC

*Winn L. Rosch is a contributing editor of* PC Magazine.

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# TRIPLE CROWN

# NEW EDITIONS OF THREE WINNING WORD PROCESSORS

*Third-generation versions of XyWrite, VolksWriter, and Microsoft Word hit the shelves this year. Will fans be enchanted with their new features—or alarmed by unexpected changes?*

Professional-class word processors, the elite members of the breed, are powerful word engines packed with a slew of advanced formatting and editing features. Contenders in this highly competitive arena are constantly developing new features and tricks for their products. But word processors generate a high degree of user loyalty, and word processing designers and programmers have to take care that the changes they incorporate in their upgrades won't offend their faithful fans.

New editions of *Microsoft Word*, Lifetree Software's *Volkswriter*, and XyQuest's *XyWrite* appeared this spring. Each of these products has been commercially successful, is highly regarded in the PC industry, and has the sort of committed following that must be nurtured. The upgraded versions reviewed here manage to keep their devotees happy: the same commands and features work in the old and new versions, and enhancements are largely consistent with each program's traditional way of doing things.

*MicroSoft Word*, Version 3.0, *Volkswriter 3*, and *XyWrite III* are all major upgrades,. and, as their names indicate, all three are third-generation programs. We asked a die-hard fan of each word processor to take a close look at the new edition. First, the reviewers ran their assigned products through the same script used in *PC Magazine*'s special issue on word processing (Volume 5 Number 2) to make sure each could still handle the same tasks in the same way. Then they concentrated on learning the new aspects of the products.

If you use an older edition of *Word*, *Volkswriter*, or *XyWrite*, you'll surely be interested in how well the new ones work. If you use another professional-class word processor, you may discover a new feature that will entice you to make a change.

Professional-class products have a reputation for being difficult to use. If you or your company use a personal or corporate word processor for that reason, read on. You may find that the advanced features of these products are more attractive than you thought. Besides, your increasing computer skills, along with substantial efforts by product designers, make these professional word processors easier than ever to use.

**—John Dickinson**

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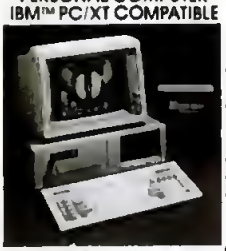

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## ■ VERSION 3 UPDATES

**PC MAGAZINE — Word Processor Programs: Third-Generation Highlights**

| | Volkswriter 3 | XyWrite III | Microsoft Word, Version 3.0 |
|---|---|---|---|
| **EDITING FEATURE** | Case-insensitive searches<br>Math functions<br>Spelling checker | Simultaneous access to nine open documents<br>Column table commands | Column functions<br>Date and time stamping<br>Paragraph autosort<br>Math functions<br>Outline processor |
| **FORMATTING FEATURE** | Automatic paragraph reformatting<br>Enhanced print formatting<br>Automatic envelope addressing | Automatic hyphenation<br>Proportional spacing | Hidden text<br>Automatic index and table of contents generation |
| **PRINTING FEATURE** | Print queueing | | User-customizable printer drivers |
| **FILE-MANAGEMENT FEATURE** | New translation utilities | Ability to search across directories and drives<br>Full DOS path support | |
| **COMPATIBILITY FEATURE** | | Compatibility with RAM-resident programs | No copy protection |
| **DOCUMENTATION FEATURE** | | Expanded help facility | On-screen tutorial<br>New documentation |

## Volkswriter 3

When computer consultant Camillo Wilson brought *Volkswriter* into the world in 1982, the IBM PC was itself but a newborn babe, with single-sided disk drives and rarely more than 64K bytes of RAM. Wilson's pride and joy soon became a popular companion for the infant PC because it was fast, easy to learn, and reasonably priced.

Over the years, as PCs have grown more powerful and users have grown more knowledgeable, *Volkswriter* has grown along with them, adding new features and greater flexibility. Now in its third generation, the program is still fast, easy to learn, and reasonably priced, but it's a babe-in-arms no longer. It boasts many of the same features as its higher-priced competitors while retaining its straightforward personality.

Although some high-end features, such as windows and an undo key, are still missing, Wilson says that *Volkswriter 3* includes the improvements most often requested by *Volkswriter* users, who are Lifetree Software's intended market. In evaluating *Volkswriter 3*, it's important to keep those users in mind. They tend to be owners of small businesses and corporate managers and their secretaries. They like the simplicity of a personal word processor such as Software Publishing Corp.'s *PFS:Write* but need more power. *Volkswriter*, which is midway in price and features between the personal word processors and the fully loaded, high-end products, meets the needs of that audience.

*Volkswriter 3* is clearly the heir of its popular predecessor, *Volkswriter Deluxe*. It sports the same logical menu structure and the same mode-less editing, which lets you move easily from text entry to editing without entering a command mode. All of *Volkswriter 3*'s editing commands are summoned by function keys, either alone or in combination with the PC's Alt, Ctrl, and Shift keys. If you forget which key does what, F1 calls a five-line crib sheet to the top of the screen. A set of embedded double-dot commands, reminiscent of *WordStar*'s dot commands, controls formatting options like headers, footers, and hard page breaks.

**ON-DISK TUTORIALS** In addition to sharing the same basic structure, *Volkswriter 3* has many of *Volkswriter Deluxe*'s bells and whistles, such as the well-designed mail-merge module and access to the full IBM character set, which allows foreign-language and scientific word processing. Also like its predecessor, *Volkswriter 3* has a fine set of on-disk tutorials that teach you all but the most advanced and arcane features. With the help of the tutorials, you could be writing and printing with *Volkswriter 3* within a couple of hours.

*Volkswriter 3* also has a lot of fancy new tricks. An integrated spelling checker springs into action at the touch of a function key to check a word, a marked block of text, or an entire document. Floppy disk users will appreciate the fact that using the spelling checker does not involve disk swapping. You need to switch program disks only once: when you load the program into memory. After that, the spelling checker and its 170,000-word dictionary reside in your drive A:. At your request it will suggest possible corrections, which it can insert into the text at the press of a key. In addition to flagging spelling errors, the spelling checker can catch some punctuation and capitalization errors.

Another new extra is automatic hyphenation. Using a set of hyphenation rules, *Volkswriter 3* automatically hyphenates words that cross into its user-definable hyphenation zone, without any pesky beeping or prompting to interrupt your concentration. The hyphenation is usually accurate, but it does mess up now and then, especially if you set a narrow hyphenation zone, requiring it to hyphenate short words. You can resolve these occasional errors by entering the correctly hyphenated word into *Volkswriter 3*'s hyphenation-exception dictionary.

Just as snazzy is *Volkswriter 3*'s new math feature. To quickly tote up a column of numbers, you just mark the column with two function-key commands, move the cursor to the place you want the result to appear, press another function key, and your total appears. The math command performs subtraction, division, and multiplication, and it can add multiple rows and columns with a single command. It will also sort tables for you, using any column


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## ■ VERSION 3 UPDATES

you choose as the sort key. You could quickly arrange an address list in alphabetical order by last name and just as quickly rearrange it by ZIP code.

**ENHANCED FORMATTING** Perhaps the biggest news about *Volkswriter 3* is its enhanced print formatting. To give you more control over the finished document, *Volkswriter* uses a new device it calls a layout, which specifies tabs, margins, line spacing, page size, justification, and other print parameters. A document can contain up to 15 different layouts, which are stored along with the document. You can create a layout on the fly while you're editing or browse through previously created layouts, selecting one that meets your needs. You can save your favorite layouts in named style sheets.

*Volkswriter 3* embeds the layout command in your text, which is where it controls the appearance of the text until it encounters the next layout command. The layout commands refer to non-ASCII formatting information that *Volkswriter 3* stores at the end of the document file. (You can still use the DOS TYPE command to review the contents of your files.)

With *Volkswriter 3*'s layouts, you can change the appearance of a document with just a few keystrokes. For instance, to change your flush-left block-style paragraphs to paragraphs with initial indentations, you simply revise the layout controlling those paragraphs to include an initial indentation. *Volkswriter 3* will automatically reformat the paragraphs to match the new layout.

Although previous versions of *Volkswriter* could also use multiple formats in the same document, you had to print the document to see the placement of page breaks. *Volkswriter 3* shows the changes while you're still editing so that you can see accurate page breaks, margins, and spacing. Like older *Volkswriter* versions, *Volkswriter 3* will permit you to edit a double-spaced document, showing accurate page breaks, without wasting screen space by actually skipping lines. If you prefer, *Volkswriter 3* can display the spacing onscreen, and so you get a closer approximation of the final printed page.

Other enhanced formatting features may be helpful for preparing your next for-


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## ■ VERSION 3 UPDATES

mal report to the chairman of the board. You can specify different print offsets and separate headers and footers for odd and even pages to facilitate binding. And you can call for a different top margin for the first page of a document.

The inevitable price for this increased power is greater complexity. It took me, a longtime *Volkswriter* user, several days to really get the hang of *Volkswriter 3*'s style sheets and layouts so that I understood when to revise an existing layout and when to create a new one.

At least one handy formatting feature from earlier *Volkswriter* versions got lost in the shuffle. You used to be able to specify a font as part of a *Volkswriter* document format. This made it easy for users of Epson MX–series printers to print an entire document in boldface type, which is the near-letter-quality font for those printers. Since *Volkswriter 3*'s layouts don't control fonts, you have to go through a separate command sequence in order to print a document in boldface, marking the text to be printed in boldface and then issuing the *Volkswriter 3* Boldface command. This inconvenience is not a terrible price to pay for the added power of layouts, but I hope the next release of *Volkswriter* gives us layouts that control fonts, as well as other formatting parameters.

Users of Epson MX–series printers will also encounter one of the program's few bugs. If you attempt to use boldface type together with headers, *Volkswriter 3* gets confused and prints the first paragraph of each page in regular type. A Lifetree Software spokeswoman says that the company is working on a fix, which will soon be available free to registered users.

Another significant new feature is *Volkswriter 3*'s automatic on-screen paragraph reformatting. In older versions of *Volkswriter*, you had to issue a reformat command if your paragraph became ragged in the course of adding and deleting text. *Volkswriter 3* can reformat the paragraph on its own, as soon as you move the cursor, signaling that you're done editing. Because there are times when you might want to protect text against accidental reformatting, *Volkswriter 3* allows you to turn off the automatic reformatting option. You can even disable the manual Reformat command by creating a layout that does

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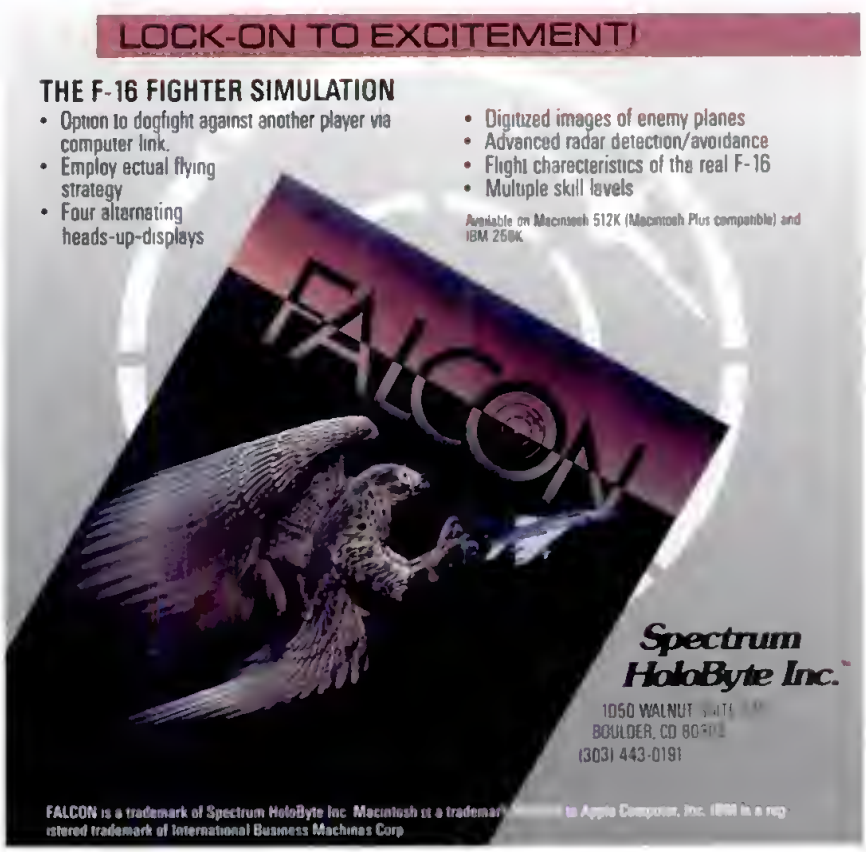

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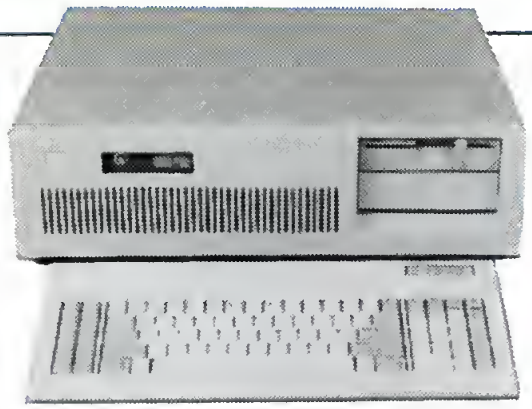

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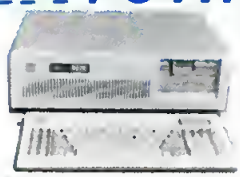

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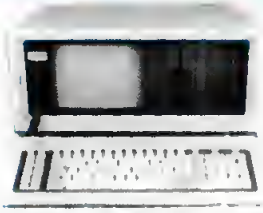

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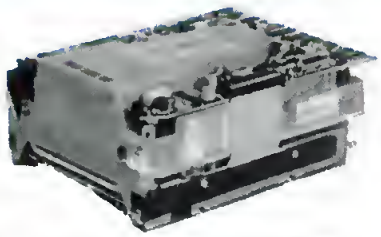

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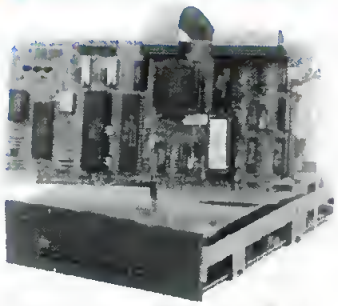

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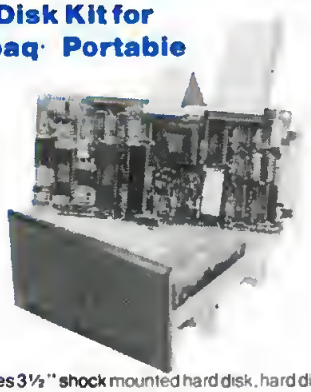

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- Dual floppy & hard drive controller
- 1.2MB floppy drive
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- Up to 70% faster processing speed
- AT style keyboard
- 1-360K half height drive
- 256K RAM expandable to 1 megabyte on motherboard
- 8 expansion slots
- Clock/calendar with battery back-up
- Game port
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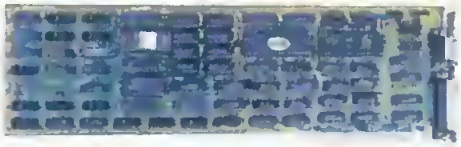

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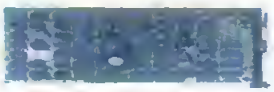

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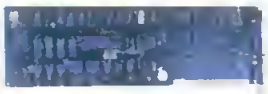

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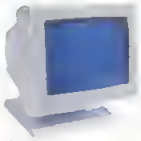

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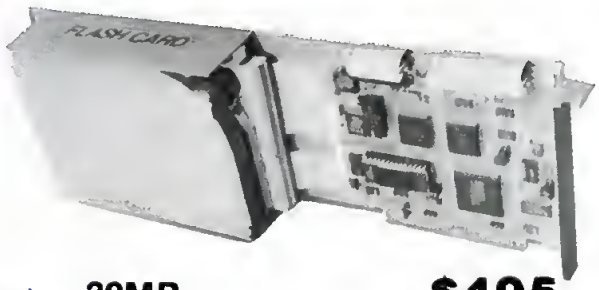


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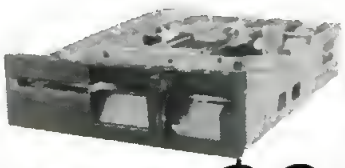

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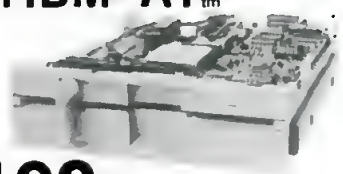

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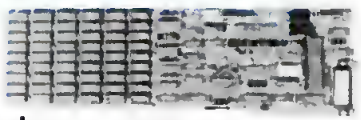

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not permit any reformatting. *Volkswriter 3* also gives you a cleaner editing screen by keeping paragraph markers and formatting codes out of sight until you need them.

**PRINT QUEUING** Also new to *Volkswriter 3* is the ability to print a document while you continue to edit. Called print queueing because the documents wait in an orderly line for their turn to be printed, this feature requires DOS 3.0 or later and a hard disk drive. Wilson explains that he decided to use the DOS 3.0 PRINT command to manage the print queue so that *Volkswriter 3* would remain well behaved and would not require revision when new versions of DOS came on the market.

To use print queueing, you have to include the PRINT statement in your AUTOEXEC.BAT file. When you choose the print queue option on *Volkswriter 3*'s print menu, the program writes the document to an intermediate disk file and then sends it to the printer. You can add documents to the queue or remove them. Printing will continue as you use *Volkswriter 3* or even if you switch to a different application.

Another new option on the print menu is automatic envelope addressing. *Volkswriter 3* can pick up the inside address from a letter and print it on an envelope. The program is even smart enough to correctly position the address, if you use a standard 9½- by 4-inch envelope. You just align the printhead with the top of the envelope, and *Volkswriter 3* does the rest.

For people who need to share documents with other word processors and with other IBM equipment, *Volkswriter 3* has a new set of utilities that can translate files to and from DCA RFT, *WordStar*, and ordinary ASCII formats. When *Volkswriter 3* reads a foreign file, it inserts paragraph markers whenever it encounters a blank line. This remedies an older *Volkswriter* versions problem, which could turn a foreign document into a single large paragraph if you forgot to insert the paragraph markers before beginning to edit.

For imported documents in which the paragraphs are not separated by blank lines, *Volkswriter 3* has an additional safeguard against accidental reformatting. The translation program creates an initial layout that forbids reformatting, so you have the chance to manually insert any missing paragraph markers before you start revising the document.

Old hands at *Volkswriter* will notice other extra goodies lurking here and there. For example, the search function can now ignore case; the directory can use DOS wildcards for display and file deletion; and the editor remembers your last cursor position when you return to a document after using another menu.

*Volkswriter 3* is a worthy scion of the *Volkswriter* line. It possesses more power and polish than its predecessors but retains both the speed and ease of use that have won *Volkswriter* its loyal following.

**—Dara Pearlman**

PC MAGAZINE FACT FILE

***Volkswriter 3*, Version 1.0**
Lifetree Software Inc.
411 Pacific St.
Monterey, CA 93940
(408) 373-4718
**List Price**: $295; upgrade, $95, plus $3 shipping and handling.
**Requires**: 256K RAM, two disk drives, DOS 2.0 or later. Print queuing requires 320K RAM, hard disk, and DOS 3.0 or later.
**In Short**: Fast, easy-to-use *Volkswriter 3* improves on *Volkswriter Deluxe* by adding spelling correction, math capabilities, automatic hyphenation, and style sheets for fast formatting. Not copy protected.

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## XyWrite III

Extraordinary speed and versatility were hallmarks of *XyWrite II Plus*. *XyWrite III*, Version 3.06, adds a host of powerful new capabilities that broaden this word processor's appeal to newcomers and are certainly worth the $100 update cost for present users.

Characteristic of *XyWrite III*'s enhancements is its treatment of the basic search capability, which lets you scan a file for one or more occurrences of a name, number, or other string. In *XyWrite II Plus*, this facility was more versatile than in most word processors, providing for forward, backward, case-sensitive, and case-insensitive searches. You could further refine your searches by using any of six different kinds of wildcard characters to help target the text you sought. *XyWrite III* takes the next step, letting you extend the search range to include all the files (or DOS wildcard-designated groups of files) in a directory—and even in multiple directories and drives. When *XyWrite* finds a match, it presents it immediately in a full-screen context; you can then choose to open the file for editing, look for other occurrences in that file, move to the next file, or simply halt the search. This feature alone saves me hours.

Similarly, while *XyWrite II Plus* could handle two documents simultaneously, *XyWrite III* can accommodate up to nine. You can access the text windows as individual full screens, horizontal or vertical split-screens, or multiple overlays, which are sized and positioned to your taste.

Command oriented rather than menu driven, *XyWrite* operates both through single-word entries (or their two-letter abbreviations) typed on a dedicated command line and through function and cursor keys (augmented with their Shift, Alt, and Ctrl variations). To simplify entering the typical set of formatting commands for beginners, however, the Alt-Tab keystroke in *XyWrite III* brings up a self-explanatory full-screen display on which you enter margins, any desired tab stops (regular, right justified, centered, or decimal), and first-line and remaining-line offsets directly on a ruler line.

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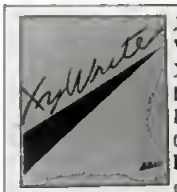


***XyWrite III*, Version 3.06**
XyQuest Inc.
P.O. Box 372
Bedford, MA 01730
(617) 275-4439
**List Price**: $395; upgrade, $100.
**Requires**: 256K RAM, one disk drive, DOS 2.0 or later.
**In Short**: A lightning-fast, highly flexible, command-driven word processor with new support for proportional spacing, column functions, and other features useful for some desktop publishing functions. Not copy protected.

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## ■ VERSION 3 UPDATES

Formatting commands take effect immediately, automatically affect all subsequent text, and may be changed as often as you like. They appear as bold triangles; when you place the cursor on a triangle, its meaning is displayed on a prompt line. An expanded-mode display, which shows all the embedded codes within European-style quote marks and permits you to edit rather than simply replace them, can be toggled on and off in place of the normal WYSIWYG display.

A major new feature of *XyWrite III* is its support for proportional spacing. The implementation includes user-modifiable width, font, and attribute tables for all printed output combinations your printer supports. Ready-to-run printer tables for more than 50 printers (including the Apple LaserWriter and the Hewlett-Packard Laserjet) are provided, as well as full-customization capabilities for all printers. While many word processors that nominally support proportional-space printers revert to character-count-based lines in their displays, *XyWrite III* counts the individual character widths and breaks lines on-screen where they will be broken on the printout, even if you mix type sizes in midline. (Proportionally spaced printouts using older daisy wheel printers that lack their own hardware-based logic can be user-implemented, but it is a painfully, slow kludge of a process. XyQuest promises to write the necessary software drivers for these machines if demand warrants.)

■ While *XyWrite II Plus* could handle two documents simultaneously, *XyWrite III* can accommodate nine.

**REMAPPING THE KEYBOARD** *XyWrite* has traditionally used many key combinations not supported by DOS (for example, Ctrl-Del deletes to the end of a line), and it further permits users to remap


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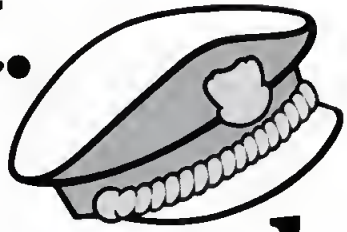

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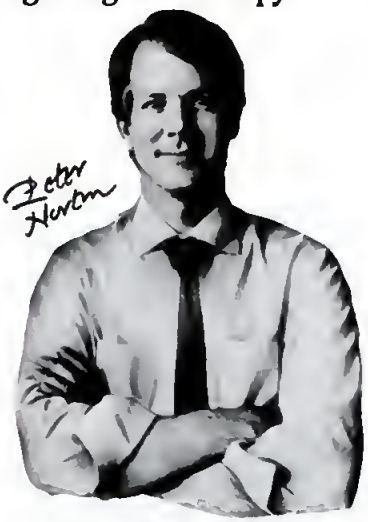


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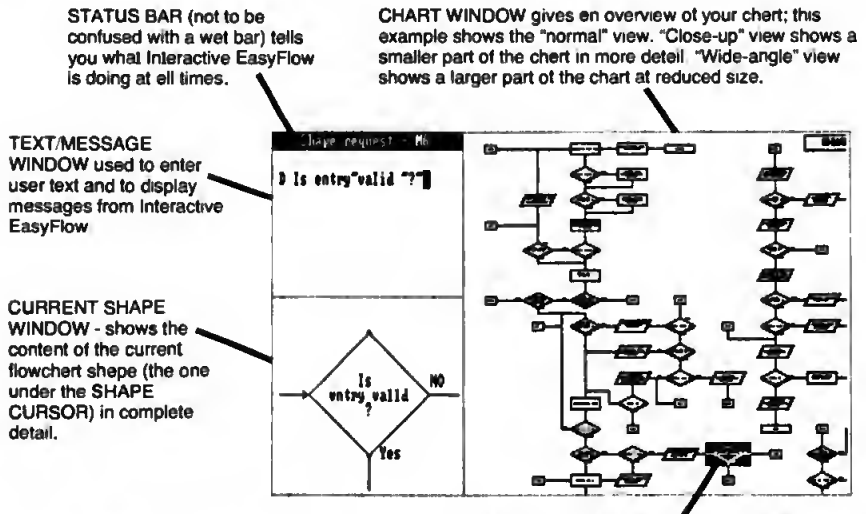


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## ■ VERSION 3 UPDATES

the keyboard at will. (*XyWrite*'s keyboard, printer, help-screen, and startup files can all be edited and subsequently loaded as ordinary text files.) XyQuest achieved this flexibility by taking over the keyboard interrupts, a procedure that has in the past resulted in incompatibility with memory-resident programs that, like *XyWrite* itself, permit extensive construction of keyboard macros.

*XyWrite III* addresses this problem in two ways. First, it provides a short (1,646-byte) program called XYKBD.COM, which is designed to be the first item loaded by your AUTOEXEC.BAT file. XYKBD.COM checks incoming keystrokes to see if they are intended for *XyWrite* or for another memory-resident program. This prevents incompatibilities with many (for example, Borland's *Turbo Lightning*), though not all, programs. Second, an absolutely compatible DOS.KBD file can be loaded (and a one-line default command inserted in your printer file) that restricts *XyWrite* to the DOS-supported range of keystrokes. Since this involves remapping so many of *XyWrite*'s command functions to unfamiliar locations (and there is not room for all implementable *XyWrite* functions), this is not an option any *XyWrite* user I know of has elected.

*XyWrite* permits you to run it in conjunction with other programs in additional ways. While editing a document, you can at any time drop into DOS to run a different application entirely. When you eventually exit from DOS, you'll be back exactly where you were in your *XyWrite* document. Indeed, you can run many DOS programs without even this intervening step, by entering, for example, the command DO BASICA directly on the *XyWrite* command line. XyQuest has added to this capacity by implementing full DOS path support in *XyWrite III*, so that files can be called from and returned to any place on a hard disk. In addition, while *XyWrite* previously permitted you to issue DIR, CD, and DEL commands directly on the command line, you can now sort directory files in forward or reverse order according to filename, extension, size, date, and time.

**NEWSPAPER-STYLE COLUMNS**
New in *XyWrite III* are two different text-column-handling facilities. Varying-width

## ■ VERSION 3 UPDATES

columns (up to 10 in the standard version, 16 on request) with full word wrap are handled by a set of column table commands. Each column may be given its own complete set of formatting and default parameters. (*XyWrite III*'s new Styles command, which allows named groups of formatting commands to be created and called directly, can be useful here. The Styles command would be far more useful, however, if you could save the templates you create

■ *XyWrite* has traditionally used many key combinations not supported by DOS, and it permits users to remap the keyboard.

with it as disk files.) Columns are displayed in normal WYSIWYG fashion. For applications in which newspaper-style column "snaking" (up to six columns, with user-selectable gutters) is desired, the entry process is much less cumbersome, though in this case to see a WYSIWYG display you must go through a type-to-screen review step.

While *XyWrite III* does not bundle either a spelling checker or an on-line thesaurus, it works (using XYKBD.COM) with most standalone programs, including IBM's *Word Proof*, the *Random House Reference Set*, *Turbo Lightning*, and *Word Finder*. The program does, moreover, include a new automatic hyphenation capability (based on the Kneuth algorithm) and a user-expandable dictionary for words whose hyphenation does not follow normal rules.

While the extraordinary speed with which *XyWrite* performs block moves and copies, search-and-replace operations, and page- or document-length scrolling are probably the most dramatic aspects of the program, its adaptability to specific user requirements may be the secret of its long-term attraction. Everything (or so it seems)


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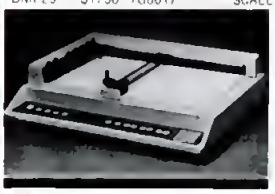

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about the program is accessible and customizable. You can use headers and footers of any length and with different formats even for left and right pages, if you like. Footnotes can appear at the bottom of the page (with different separators of your choosing for notes that carry onto a second page) or as end notes. For outlining, paragraphs can automatically be numbered in *XyWrite III* using up to ten counter levels, selectable among regular numbers, Roman numerals, or letters of the alphabet.

**ALL OLD FEATURES IN TACT** All the traditional features of *XyWrite* have been retained, and none of its wonderful flexibility lost. If you want "dead" keys for foreign accents or you want to add an unimplemented function call by assigning it to an unused function key or you want to change the normal "soft" hyphen from the default tilde to the Alt-hyphen so it won't ignore the carriage return symbol used in *1-2-3* macros, it's still extremely easy to modify the keyboard file.

Even easier is the creation of keyboard macros (known in *XyWrite* as save/gets), which can contain anything from a few keystrokes to whole document-length texts. A handy feature is the ability to append new text to old save/gets, which allows you to concatenate strings as you go. *XyWrite* permits up to 36 save/gets to be active at once, and these can be either temporary or—like any defined (blocked) section of text—can be stored to a file. More ambitious users can construct, store, and run whole programs from the save/get key.

■ A handy feature is the ability to append new text to old save/gets, which allows you to concatenate strings as you go.

While modifying your printer file to change its width tables, substitute different characters, and create new combinations of attributes for printout is tedious, it is feasible—given the clarity of the reference manual—for most users. (In *XyWrite III*, these tables are still ASCII editable, but you have to learn a completely different syntax and vocabulary.) It's far easier, however, to make custom changes in the default values for automatic backup, formfeed at end-of-file, and the colors used to


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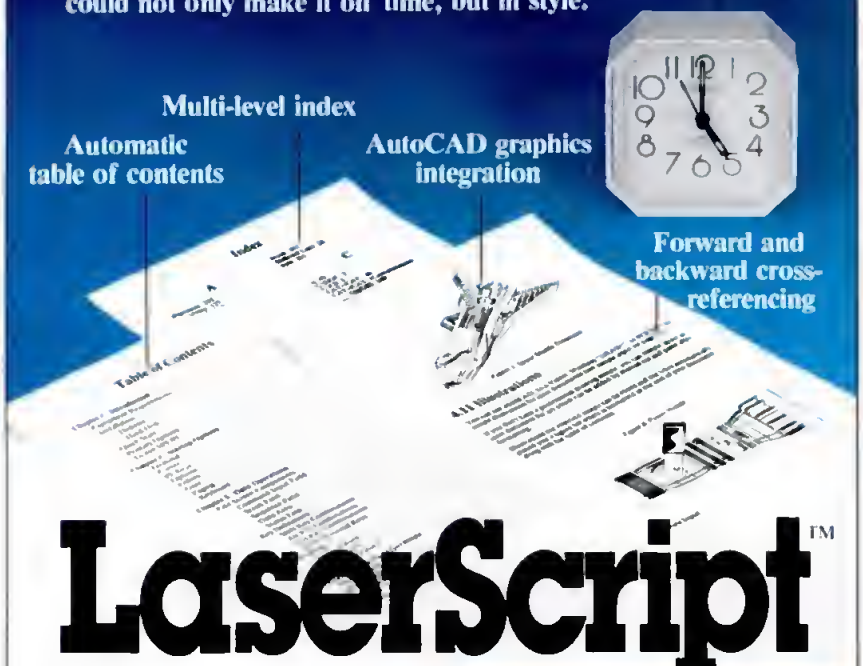


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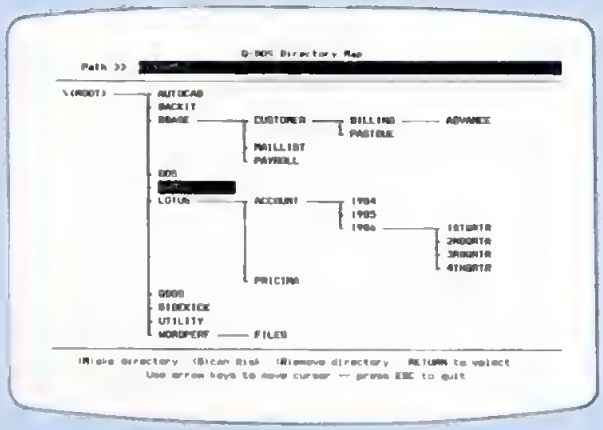


This easy-to-read directory map shows you all directories on the disk while allowing effortless creation and removal of directories One keystroke gives you access to any directory on any disk *Seeing the directory structure in this way helps you better understand your hard disk*

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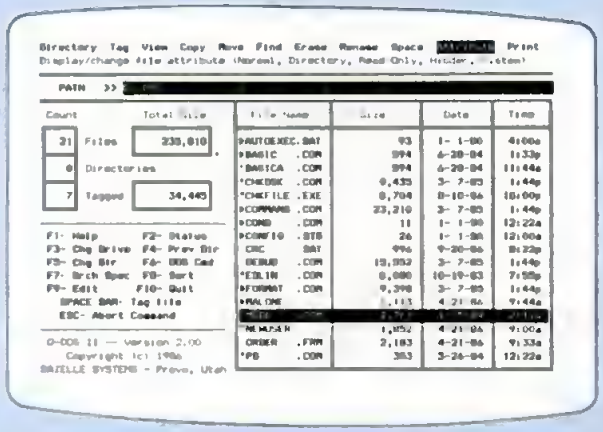


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display *XyWrite*'s modes (normal, bold, underline, reverse, bold underline, bold reverse, superscript, subscript, and default to surrounding display mode). These defaults, which are stored in the printer file, are loaded with the program and can be changed and reloaded with a few keystrokes. For that matter, you can load another entire printer file at any time.

*XyWrite III* had no problem handling the series of editing tasks in the test program. Its mail-merge facility worked perfectly well, and I could do the math, though I had to add commas to the amounts manually. In addition, I found that the bug in the *XyWrite II Plus* Pause command has been eliminated, so it's easy now to stop in midline at an exact point to change print wheels, for example.

**EXTENSIVE HELP** *XyWrite III*'s reference manual is extensive (524 pages) and very clearly written. In addition, the program supplies several tutorial and setup manuals (installation, quickstart, basic word processing, and applications), a plastic template for function-key identification, and a few sample files on a "training disk." The tutorials, while clear enough, are paced at the level of a real beginner. On the other hand, users at all levels will welcome improvements *XyWrite III* has made in terms of on-screen help files. The program does not supply automatic context-sensitive help, but it does offers on-screen assistance and explanation in any one of three forms: a traditional, terse set of screens (OLD.HLP), which will be of use primarily to users who are already familiar with *XyWrite II Plus*; a SHORT.HLP file, which covers most of what a user with a little experience of the program may have forgotten; and a LONG.HLP file (170K), which offers near-reference-level instruction. These help screens can themselves be edited and modified (by a knowledgeable user) to customize them for particular corporate environments.

■ Users at all levels will welcome improvements *XyWrite III* has made in on-screen help files.

If *XyWrite* remains somewhat harder to learn than many other word processing programs, it offers in return almost limitless possibilities for customization to match your individual work habits. The standard version even supports the use of up to five network drives, and EGA users can request (at no charge) a version that


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supports 43-line displays (actually, up to 66). For speed and flexibility in serious word processing, *XyWrite III* is far and away this editor's choice.—**Craig L. Stark**

## Microsoft Word, Version 3.0

*Microsoft Word*, Version 3.0, is the most elegant word processor I've ever used. Its elegance lies not in its graphics display (although it does look very pretty in rainbow colors on an EGA screen) or in its WYSIWYG screen format that shows you italics, underlines, double underlines, and other print features exactly as they will actually be printed, or in its ability to work with a mouse (I usually don't). *Word* is elegant because it is thorough and consistent in everything it does.

*Word* is easily one of the most thoughtfully designed software products ever developed for any type of computer. Conceived as a power user's word processor, *Word* included in its first edition (introduced in 1984) an array of features that exceeded the ordinary bounds of word processors. Yet *Word* is smooth and facile to use despite these advanced features because its command structure and behavior are consistent throughout and include the sort of details that other products often omit.

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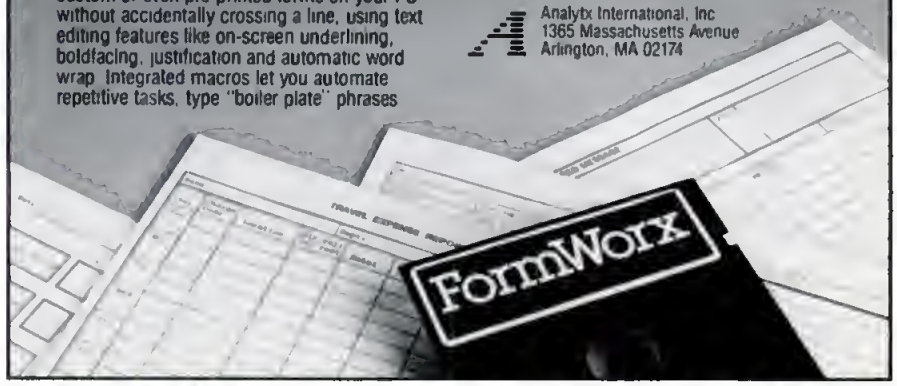


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correctly regardless of the make or model of your printer. If you trace the editing events that lead to that result, you'll discover that accurate printing was the goal of *Word*'s designers from the outset and that nearly every editing feature of the program is oriented to reaching that objective as smoothly as possible. That's an important and appropriate characteristic of a word processor for a business world in which a "paperless office" is but a pipe dream of science-fiction fans.

**EVOLUTIONARY FEATURES** With each new edition, Microsoft Corp. has extended *Word*'s power, enhanced its elegance, and increased its speed, and *Word*, Version 3.0 (released last April), is no exception. Microsoft officials like to call the new release of *Word* evolutionary rather than revolutionary, and they are right to do so. Its new features are not earth-shattering or, in most cases, even unique. But Version 3.0 is outstanding nevertheless because throughout its new features it maintains the consistency of operation and (mostly, at least) attention to detail that have made it so attractive. Current users will have no difficulty adjusting to the new version.

New features allow you to create indexes and tables of contents automatically, define and use hidden text without restrictions on what type of text it is (header or table of contents entry, for example) or where it is, sort paragraphs in a variety of ways, do arithmetic in tabular columns or anywhere else, define and use vertical column blocks, align column components horizontally, and create outlines using Microsoft's implementation of a Living Videotext *ThinkTank* clone. Some menu and other operational changes result in even greater ease of use.

*Word*'s printer support has been enhanced in Version 3.0, especially for laser printers, and Microsoft now ships a guide, called *Printer Information*, that makes it easier to define your own customized printer drivers (an especially good idea because the new drivers are incompatible with old ones and customized versions will have to be changed).

The user manual has been rewritten and expanded into two volumes: *Using Microsoft Word* and *Reference to Microsoft Word*. Each volume includes a complete index indicating topic locations in both. The best documentation news of all, however, is *Word*'s new on-screen tutorial. Microsoft improved upon the already outstanding tutorial supplied with Version 2.0, and then went a step further by integrating it into *Word*'s context-sensitive online help facility. Anytime you ask for online help and find that the information


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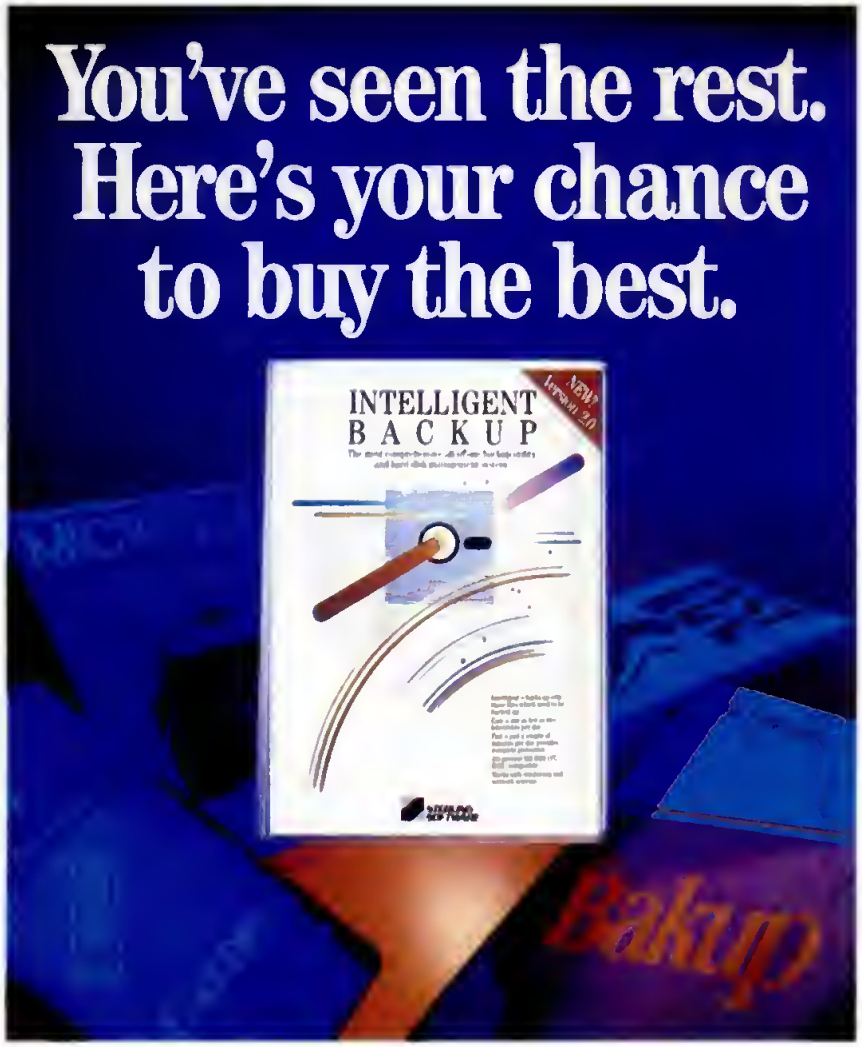


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## ■ VERSION 3 UPDATES

provided doesn't quite answer your question, you can start the *Word* tutorial at the press of a key. The tutorial system is context-sensitive like the help system: it will run the section appropriate to your current task (and, presumably, your dilemma), or you can peruse the tutorial index to find and run a different lesson.

**OUTLINE PROCESSOR** Version 3.0's most impressive new feature is its outline processor. The touch of a function key will change *Word*'s word processing mode from ordinary text editing to outline editing (it's also an option in the window menu), and you'll barely know that you're not using *ThinkTank* until you press the same key to change back. Outlines can include headings and text, and large or small chunks of each can be contracted to hide them from view, or expanded again, at the touch of the gray Plus and Minus keys.

Outline levels for headings and text can be promoted and demoted at the touch of a key, and you can even change your mind and convert a heading into text or vice versa. *Word* lets you automatically number your outline using standard or legal formats, and you can change your mind about which format at any time. You can also easily renumber or "unnumber" the outline. *Word* can sort a section, or all, of your outline (or any other group of paragraphs) if you want to maintain an alphabetic or numerically ordered list, and you can reorder the outline by using block edit commands that work somewhat differently in outline mode. Headings and text can be formatted by ordinary means or take advantage of *Word*'s style sheets (predefined format specifications available to any document); Microsoft has even included special paragraph variants for outline style sheets.

You can use your finished outline as the basis for your finished document because the full array of text-editing features are available to you. Take care, however, because when you contract large blocks of text, the document can easily get larger than you'd ordinarily want it to be. *Word*'s new outline-to-document feature isn't quite as powerful as the "thinking machine" included in Ashton-Tate's *Framework*, but it's close in concept and equally easy to use.

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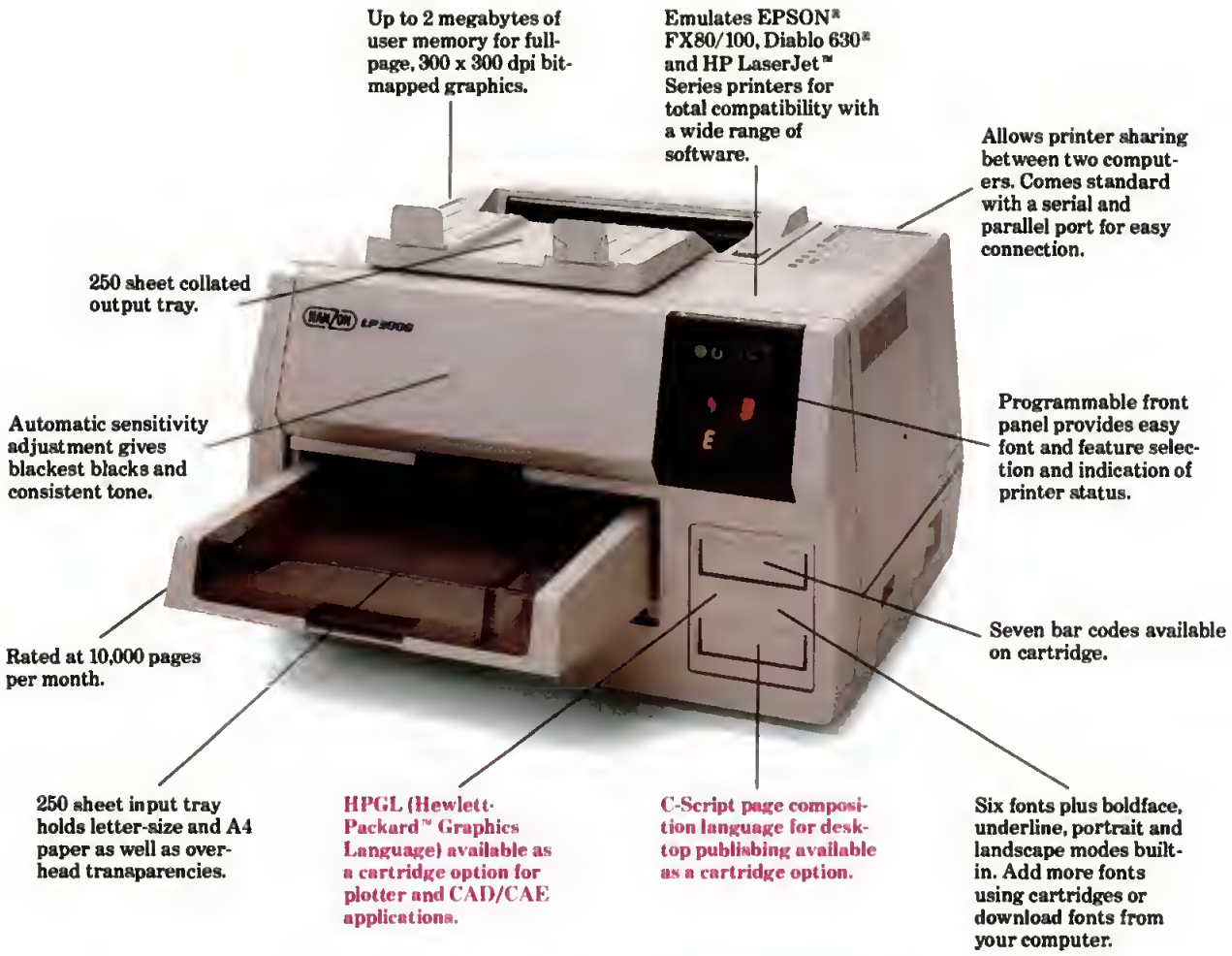


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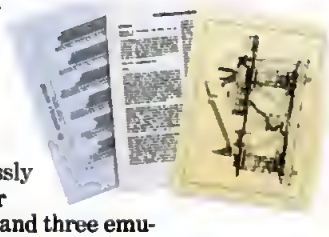

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## ■ VERSION 3 UPDATES

**AUTOMATIC INDEXING** Version 3.0 includes automatic index and table of contents generation. Both features require you to use special characters in hidden text (also new for Version 3.0) to specify which elements of your document are to appear in the index or table of contents. Both features work well and quickly and automatically place the results at the end of your document. You can use *Word*'s standard format either to modify the formats using direct formatting or to specify style sheet formats using the new reserved paragraph variants.

The index and table of contents features are consistent with the rest of *Word*'s design philosophy, but they are not as well thought out as they might have been. You have to use special hidden characters for each, yet there is no predefined key to generate them. You can create your own glossary (*Word*'s text macro facility) entries to solve the problem, but this is not the elegant kind of solution I expect from Microsoft. An added fault of the index feature is that there is no option that forces *Word* to automatically locate every occurrence of a word you want in your index—you must mark each occurrence yourself. That could be a problem in applications in which thoroughness, rather than context, is the raison d'être for each entry in an index.

*Word*'s hidden text is the best implementation of this feature I've seen. Hidden text is just another character format as far as you're concemed, which means there are no restrictions about where it can appear. You can "unhide" the text at any time, request that *Word* indicate where it is (it uses the horizontal double arrow), or display it on-screen even though it's hidden (it will be marked by a fine dotted line running underneath). Unless you unhide it or show it on-screen, the hidden text won't be printed, and paragraph and page formats will be adjusted to compensate for its absence.

When *Word*, Version 2.0, was released, Microsoft barely had time to get the program to work on IBM's then-new EGA graphics screen. As a result, the program didn't take advantage of the EGA's 43-line format (*Word* has always supported 43 lines on a Hercules Graphics screen). That limitation has been fixed, and *Word* 3.0 will display the smaller but highly legible characters in either graphics or text mode on an EGA or a compatible graphics system. Unfortunately, *Word* does not allow you to change screen modes from within the program; you have to leave and restart *Word* in order to switch from ordinary (25-line) to 43-line mode.

The autosort and math features are delightful to use and will serve you well if you need to manage tables of information in your documents. To use autosort, you simply define a vertical block of text or numbers containing your "sort key" data, then request autosort to run. Sort options include ascending or descending sequence, alphanumeric or numeric sort, case sensitivity or insensitivity, and defined column-only sort. Each paragraph (presumably one line long in most cases in which you'll use autosort) will be treated as a record and sorted according to the options you select. The exception is the column-only option, which sorts only the defined block and leaves the rest of the line or paragraph alone.

*Word*'s math feature is equally easy to use. Just specify the calculation you want to make by typing it in and defining it in a block. Pressing the F2 key inserts the result into *Word*'s scrap (a holding area for text you copy to it or delete), and you can use the Ins key to insert it where you want in your document. *Word* supports the usual operators (+,-,*,and/), with addition as the default for cases in which you supply no operator (handy for columns in which you wouldn't want to type in all those plus signs). If you want, you can hide the operators in a document you intend to update at a later time, rather than delete them. Additional nice touches (*Word*'s detail mavens were busy here) are that the program understands standard accounting notation for negative numbers (parentheses around the numbers), correctly recognizes and uses percent signs, and understands the presence of commas in large numbers.

Autosort and math work well with ordinary tables that are defined by tabs, and the result is a decent table manager for business documents. *Word*'s ability to handle text columns can also come into play, and table management becomes even more powerful when you add *Word*'s new ability to align text columns horizontally. You no longer have to guess where things are going to land when you want, for example, a single horizontal line of text in the leftmost column to line up with the first line of a paragraph on the right in order to serve as a header for that text. Producers of sales or other business proposals, consulting reports, training documents, and some types of scripts will be overjoyed.

A small but attractive touch is date- and time-stamping for *Word* documents. You can insert the current date or time, or the document printing date or time, from *Word*'s built-in glossary. Time is indicated in hours and minutes with the PM or AM suffix, and the date uses the full spelling of months. Placement is not restricted; you can put the date and time in a running header or footer or anywhere you choose.

**TORTOISE-LIKE SPEED** Word's biggest weakness has always been its lack of speed, and, while Version 3.0 makes some important improvements, it's still not as fast as it should be. *Word*'s screen scroll rate is relatively slow, especially when used with CGA or EGA graphics mode on a standard 8088-driven PC or XT. Things improve a bit if you use a monochrome screen or a color screen in text mode. However, Version 3.0 starts much faster (Microsoft's removal of the copy-protection scheme is mostly responsible for that) and loads and stores files much faster than earlier versions.

*Microsoft Word*, Version 3.0, is the right product for you if you want a thorough and thoughtful word processor. Its powerful array of features and its accurate printing are also important selling points. Be aware, however, that most experienced *Word* users strongly recommend a hard disk system (although Version 3.0 is much better on floppy disk drives than earlier editions), and that, in my opinion at least, *Word* practically requires an 80286-driven AT or a compatible. Anything less may make you a frustrated user of a great product.—**John Dickinson**

---

*John Dickinson is editor of* Computers in Banking *and a contributing editor of* PC Magazine. *Dara Pearlman is a free-lance writer and computer programmer who lives and works in the Silicon Valley. Craig L. Stark is technical editor of* PC Magazine.

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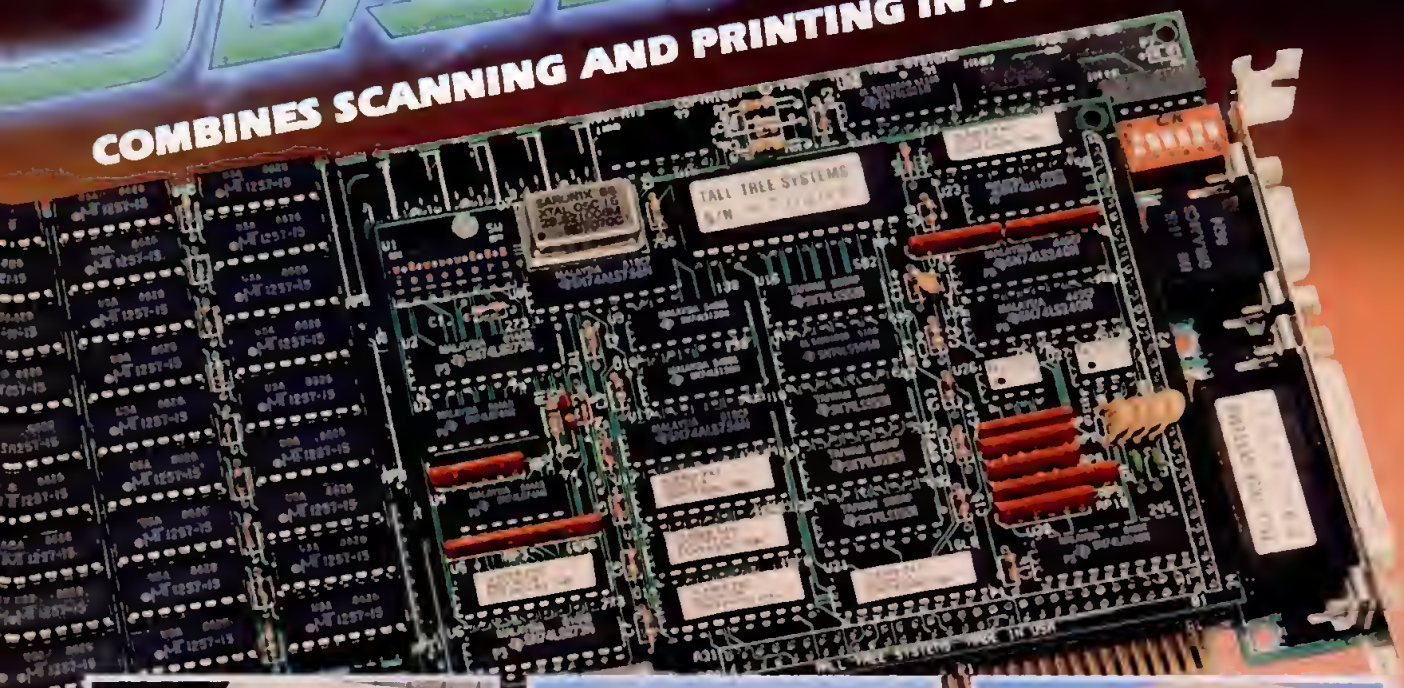

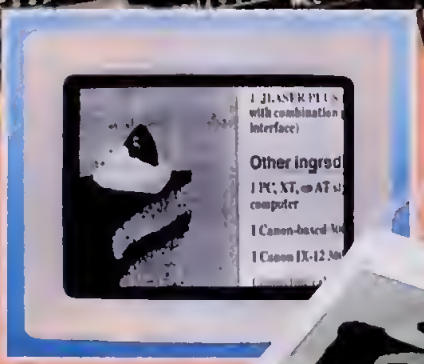

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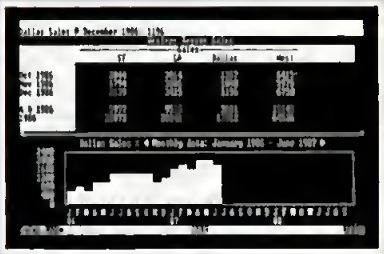

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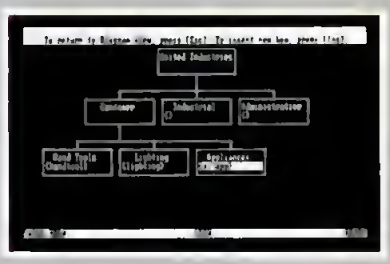

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■ PC LAB NOTES: SPEEDING UP BASIC ■ ETHAN WINER

# INTERFACING BASIC AND ASSEMBLER, PART 1

*In this first of a two-part series, you'll master the basics of the BASIC–assembly language connection and learn about stack operations.*

BASIC has always been the most popular language for PCs. It's easy to learn, easy to use, and it usually comes for free. Moreover, if you make a mistake, you can always count on getting a (reasonably) clear error message in English. Lately, however, BASIC has come in for a lot of abuse. Critics complain that it encourages poor programming habits and that it's too slow for serious programming. I'd argue the first point: you can write lousy code in any language. However, there's no disputing that, being an interpreter, BASIC isn't very fast.

In this article, I'll show how to speed up BASIC enormously by adding assembly language subroutines. I'll also present several complete programs that illustrate how to access DOS and BIOS services directly. In the examples shown here, the code bytes will be included as BASIC DATA statements. This allows keeping all of the code within a single program listing. Alternative methods for adding assembly language routines to BASIC are discussed in the sidebar "Ways of Attaching Assembly Language to BASIC."

**PUTTING PRTSC TO WORK** The best way to see how to merge assembler into BASIC is to start with an example. The PrtSc program below sends the contents of the display screen to a printer from within a running program, just as if you'd pressed the PrtSc key. It works simply by calling an existing routine in the PC's BIOS. All of the BIOS (and DOS) services are accessed by software interrupts, so all PrtSc needs to do is specify the correct one. The assembler code looks like this:

```
INT 5       ;call BIOS interrupt 5
RET         ;return to BASIC
```

Not much to it, is there? Notice how an assembly language subroutine ends with a Return—just as in BASIC. All we have to do now is convert the assembler instructions to their corresponding bytes of code, then read them into the BASIC program. The first part of the program is

```
100 '----- PRTSC.BAS
110 '
120 PRTSC$ = SPACE$(3)
130 FOR X = 1 TO 3
140   READ BYTE$
150
MID$(PRTSC$,X,1)=CHR$(VAL("&H"+BYTE$))
160 NEXT
170 DATA CD, 5, CB
```

## ■ PRODUCTIVITY INDEX

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At this point in the program, PRTSC$ contains the instructions necessary to call BIOS interrupt 5 and return to BASIC. The three DATA values come (as we'll see shortly) from the assembler routine. The last step is to find where PRTSC$ is located in memory, so we can call it when needed. BASIC provides the VARPTR function for exactly this purpose.

```
180 X = VARPTR(PRTSC$)
190 PRTSC = PEEK(X+1) + 256 * PEEK(X+2)
200 CALL PRTSC
```

Notice that line 190 seems to introduce an extra step. The reason for this is that when you ask BASIC for the VARPTR to a string, what it returns is the address of a string *descriptor*. A descriptor is a 3-byte table containing information about the string—that is, its length and address. Therefore, you must skip over the length byte at PEEK(X) to find the address of the actual string data. This address is stored in the 2 bytes at PEEK(X+1) and PEEK(X+2). Observe, too, that memory addresses range from 0 to 65,535 and always occupy one word (2 bytes). The byte at the higher address must be multiplied by 256 to obtain its final value.

Since BASIC often moves strings around in memory while a program is running, it is important always to use VARPTR immediately before calling an assembly language routine. If you needed to call PrtSc several times in a program, you would probably make lines 180 through 200 into a subroutine. That way, no matter where PRTSC$ happened to be in memory at the time, the correct address would always be called.

## ■ PC LAB NOTES

**FUNCTION CALLS** The BIOS provides a dedicated interrupt for PrtSc, but many functions must use the same software interrupt number. You can see how this works by examining the GetDrive program, which retrieves the current default drive. DOS contains a routine that does this, so all you have to do is call DOS appropriately.

Most of the DOS services are accessed through interrupt 21h. But since there are many different services available, you must tell DOS which one to use by placing a *service number* in one of the 8088's registers. AH is always used for this purpose. Likewise, DOS uses these registers to return information to a calling program.

■ You must tell DOS which function to use by placing a *service number* in register AH.

Here are the key components of the GetDrive program in assembly language:

```
MOV  AH, 19H  ;"move" the number 19h into AH
INT  21H      ;call DOS to get the drive
```

DOS puts the number of the current drive in the AL register before returning. If the current drive letter is A, then AL will be set to 0; if it is B, AL will be 1, etc. All you have to do now is to take the number in AL and put it into a BASIC variable.

The BASIC CALL command allows passing the address of a variable to an assembly language routine. Since GetDrive returns an integer, it makes sense to pass an integer variable to it. That way, GetDrive can locate the variable and set it to a new value that will indicate which drive is the default. (Whenever a numeric variable is passed to any of the assembler routines in this article, it will be an integer. Floating-point variables and numbers are stored very differently from integers and are much more difficult to work with.)

Variable addresses are passed on the 8088's stack when a subroutine is called. For a fuller explanation of the stack, see the sidebar "How the Stack Works." The stack is an area of memory set aside for this purpose, and one of its attractive features is that programs such as GetDrive don't need to know where it is. By using the Stack Pointer (SP) and Base Pointer (BP) registers, an external routine can locate any variables included in the BASIC CALL. From within your BASIC program the syntax for GetDrive is simply

```
CALL GETDRIVE(DRIVE%)
```

Just before BASIC calls GetDrive, it

## HOW THE STACK WORKS

An understanding of the stack can be one of the most difficult things for beginning assembly language programmers to grasp. But there's really no reason to be confused; it's just another part of the PC's memory. The stack has three primary purposes:

(1) To hold the address to return to when a subroutine has finished.

(2) As a place to pass variables between programs.

(3) For temporary storage of intermediate calculations.

Items are usually placed on the stack with the PUSH instruction and retrieved from it with POP. However, you may also access the stack directly with normal MOV commands. Though the stack is allowed to have its own separate segment of memory, it frequently uses the same segment as do other parts of a program. In BASIC, the stack shares the data segment with your program and its variables. This simplifies the interaction with assembly language programs.

Two of the 8088's registers, the Base Pointer (BP) and the Stack Pointer (SP), are dedicated to addressing the stack. The Stack Pointer always holds the address of the most recently PUSHed stack data and must never be changed by your programs. The Base Pointer may be changed, though only if restored to its initial value before returning to BASIC. This is why programs that need to access the stack's data should always PUSH BP before altering it. Once saved, SP may be moved into BP to get at the variable addresses that have been passed.

To illustrate the stack activity that occurs when an assembly language program is called, let's use GetDrive as an example and trace the chain of events. When BASIC encounters the CALL in

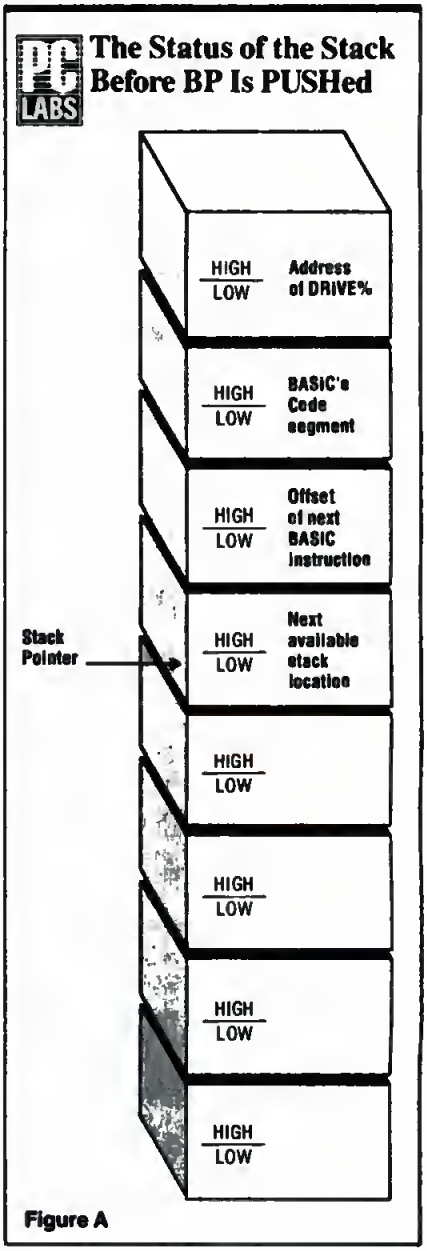

Figure A

**The Stack Grows Downward After BP Is PUSHed**

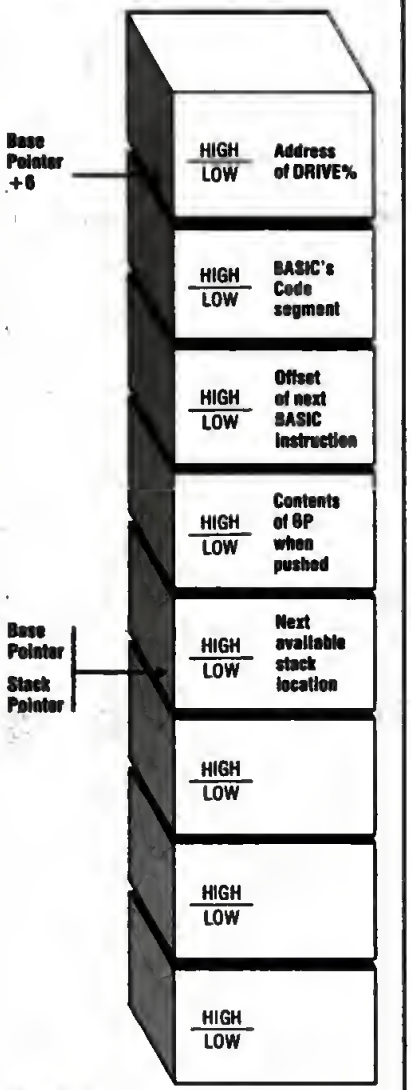


Figure B

pushes the address of DRIVE% onto the stack. Figure 1 contains the complete assembly language program showing how GetDrive can find the address.

The first thing any routine that uses the stack must do is to save the Base Pointer register, though as you can see, it may be saved onto the stack itself. Since BASIC uses BP too, we must be able to restore it before returning. Information is placed on the stack with the PUSH instruction and retrieved from it with POP. Next, the stack's your program, the first thing it does is to PUSH the address of DRIVE% onto the stack. It then performs an assembly language call to the address that was specified. For example, if BASIC's data segment happens to be 1200h and the GetDrive routine is located at address 3456h within that segment, then BASIC will execute the instruction

```
CALL 1200:3456
```

The 8088, as part of its own internal handling of CALLs, will PUSH the return address (the next BASIC instruction) onto the stack as well. Therefore, when GetDrive begins there will be three items already on the stack: the segment and offset to return to in BASIC, and the address of DRIVE%.

Each of these items occupies one word (2 bytes). Because of the order in which these words were placed there, DRIVE% will be the third in the list when referenced to the Stack Pointer. But since the first thing GetDrive does is also to push BP, it will be the fourth word when the address of DRIVE% is finally retrieved.

The stack looks as shown in Figure A before BP is pushed. Notice how it grows downward towards lower memory addresses as new items are added to it.

Once BP has been PUSHed (see Figure B) and the Stack Pointer has been MOVed into BP, BP can then be used to get at the stack's data.

When GetDrive has finished, it POPs BP, restoring it to its original value for BASIC. Finally, GetDrive's RET 2 instruction causes the processor to take the segment and address from the stack, adjust SP 2 extra bytes upward to discard DRIVE%, and then return to BASIC.

—Ethan Winer

address is put into BP, and the address of DRIVE% is placed into the SI register for later use.

Since DOS returns the current drive in AL, putting that into the variable DRIVE% would be sufficient, but it's easy to add 65 to AL first. Doing so will convert the DOS drive identifier to an ASCII character, which simplifies things for the BASIC program.

Unlike PrtSc, GetDrive relies on a variable being passed to it through the stack. Consequently, when it returns to BASIC, it must tell the 8088 that the extra word on the stack (the address of DRIVE%) is to be discarded. The last instruction in the assembler routine (Figure 1) specifies that 2 bytes are to be removed before returning control to BASIC. Had two parameters been passed, the instruction would instead have been RET 4.

■ Unlike PrtSc, GetDrive relies on a variable being passed to it through the stack.

The final BASIC program is shown in Figure 2. The DATA lines have been commented to show their relationship to the assembler routine of Figure 1. To use the GetDrive routine from within another program (you don't usually need a standalone program to tell you what drive you're in!), all you have to do is read the DATA statements once near the beginning of your program. Then simply GOSUB to the lines that locate and call GETDRIVE$ each time it is needed.

**ADDRESSING IN ASSEMBLER** One important syntactical detail I haven't yet discussed is the difference between designating numbers and addresses in assembly language. Figure 3 shows the same assembler instruction (MOV) with different variations in syntax.

Whenever a number or register is enclosed in brackets, a memory location is being referred to. Otherwise, the value of

■ PC LAB NOTES

# WAYS OF ATTACHING ASSEMBLY LANGUAGE TO BASIC

There are several popular methods for combining assembly language subroutines with BASIC, and each has its advantages and disadvantages. Using strings to hold the assembler code, as done in this article, simplifies memory management by keeping the routines within BASIC's data segment. However, it takes space away from your programs and—even worse—by storing all of the code bytes in data statements, it keeps the same information twice. Reviewing the pros and cons of each of the various means through which assembler routines are combined with BASIC may be useful at this point.

The code bytes may be put into a string either of two ways: by reading the bytes from data statements or by reading them in from disk. Strings have an inherent advantage in that they are comprised of single bytes rather than pairs of bytes, as integers are.

It would be very convenient indeed if a program could simply LINE INPUT the assembler code. Unfortunately, however, whenever a 13 (Carriage Return), 10 (Line Feed), or 26 (^Z, End-of-File) came along, BASIC would not be able to digest it properly. Furthermore, using a string restricts the assembler routines to 255 bytes and requires keeping extra files on the disk, which could complicate things for an end user. Finally, locating the code requires the extra step of first finding the string's descriptor before the address to call is known.

If strings are to be used with a separate code file on disk, the best approach is to treat the file as random access. This allows reading it in directly after assembly, ignores special values that would confuse BASIC, and steals the least memory. Another big advantage is that the size of the file does not need to be known in advance. A suitable way to read the files would be:

```
10 OPEN "TEST.BIN" AS #1 LEN = 1
20 TEST$ = SPACE$(LOF(1))
30 FIELD #1, 1 AS BYTE$
40 WHILE X < LOF(1)
50     X = X + 1
60     GET #1, X
70     MID$(TEST$, X, 1) = BYTE$
80 WEND
90 CLOSE
```

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**INTEGER ARRAYS** Storing assembler code in an integer array is also popular, though some variations are better than others. If you do elect to use an array, don't attempt to assign the elements directly. Since each element in the array occupies 2 bytes, endless calculations will be required to swap the individual bytes around to form the integer words. The example in the back of the BASIC interpreter manual aptly illustrates how awkward this can be.

A better way to use an integer array for storage is either to read the bytes as data statements and POKE them into the array, or to BLOAD a file from disk. Before either POKEing or BLOADing, however, you must ask for the VARPTR to the first element in the array. Also, it is a good idea to issue a DEF SEG command just before POKEing, in case SEG had been altered earlier in the BASIC program.

BLOADing presents a whole new set of problems for the programmer because you can't just BLOAD anything. BASIC expects the file to have a special header that is normally created when data is BSAVEd. Again, the BASIC manual shows how messy BLOADing can be, as it attempts to explain how to simulate this header.

You might think that if strings are not being used, the code won't move around in memory, thus allowing VARPTR to be used only once. Unfortunately, you would be wrong. While it's true that numeric arrays aren't constantly relocated to new addresses every time they are assigned like strings, the sad fact is that they do occasionally move. The following example illustrates this:

```
10 DIM TEST%(186)
20 X = 0 : BYTE$ = ""
30 TEST = VARPTR(TEST%(0))
40 DEF SEG
50 FOR X = 0 TO 211
60      READ BYTE$
70      POKE TEST + X, VAL("&H" + BYTE$)
80 NEXT
90 DATA 55, 8B, EC, 8B, . . .
```

Notice how both X and BYTE$ were preassigned prior to getting the VARPTR to the TEST%() array. To keep everything neat and tidy, BASIC keeps all of its arrays together in one place in memory, immediately following the regular nonarray variables. Even if an array has already been dimensioned, however, assigning a new variable causes BASIC to move all arrays upwards in memory to make room.

**—Ethan Winer**


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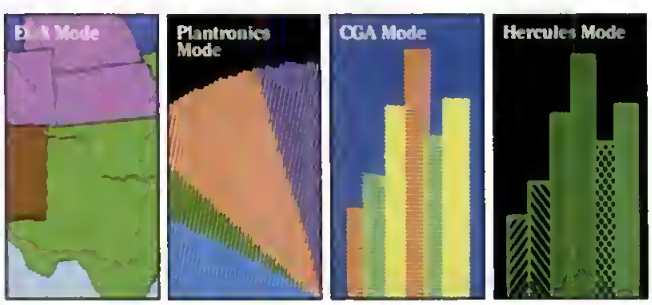


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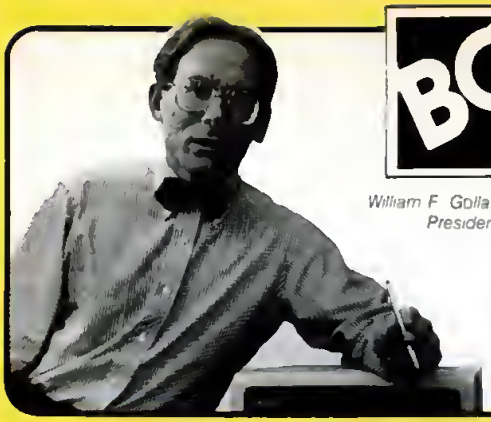

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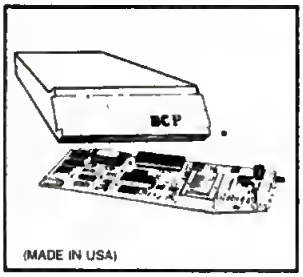


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## ■ PC LAB NOTES

```
Puah BP              ;save baae pointer for BASIC
Mov  BP, SP          ;put stack pointer into BP
Mov  SI, [BP+6]      ;put addreaa of DRIVE% into SI
Mov  AH, 19h         ;apecify service 19h - get drive
Int  21h             ;call DOS
Add  AL, 65          ;convert to ASCII character
Mov  [SI], AL        ;put AL into DRIVE%
Pop  BP              ;reatore BP
Ret  2               ;return to BASIC discarding DRIVE%
```

**Figure 1:** *The assembler subroutine for GetDrive.*

```
100 '----- GetDrive.Baa
110 '
120 GETDRIVE$ = SPACE$(18)
130 FOR X = 1 TO 18
140     READ BYTE$
150     MID$(GETDRIVE$, X, 1) = CHR$(VAL("&B" + BYTE$))
160 NEXT
170 DRIVE% = 0           'aaaign DRIVE%
180 GOSUB 310
190 PRINT "The current drive ia " CHR$(DRIVE%)
200 END
210 DATA 55              :'Push BP
220 DATA 89, E5          :'Mov  BP, SP
230 DATA 8B, 76, 06      :'Mov  SI, [BP+6]
240 DATA B4, 19          :'Mov  AH, 19
250 DATA CD, 21          :'Int  21
260 DATA 04, 41          :'Add  AL, 65  (41 hex)
270 DATA 88, 04          :'Mov  [SI], AL
280 DATA 5D              :'Pop  BP
290 DATA CA, 02, 00      :'Ret  2
300 '
310 X = VARPTR(GETDRIVE$)
320 GETDRIVE = PEEK(X+1) + 256 * PEEK(X+2)
330 CALL GETDRIVE(DRIVE%)
340 RETURN
```

**Figure 2:** *The GETDRIVE.BAS data statements come from the assembler subroutine.*

```
1) Mov AX, 6     ;move the number 6 into regiater AX
2) Mov AX, [6]   ;move contenta of memory location 6 into AX
3) Mov BX, 90    ;put the number 90 into BX
   Mov SI, [BX] ;put the contenta of memory location 90 into SI
```

**Figure 3:** *Syntax for referencing numbers and address contents in assembler.*

| BASIC | ASSEMBLER |
|---|---|
| BP = SP | MOV BP, SP |
| SI = PEEK(BP+6) | MOV SI, [BP+6] |
| SI = 4 | MOV SI, 4 |
| POKE SI, 4 | MOV [SI], 4 |

**Figure 4:** *Analogues between assembler syntax and BASIC PEEK and POKE statements.*

that number or register is assumed. The first example in Figure 3 assigns the value 6 to register AX, while the second places the contents of memory location 6 into AX. The third example has two parts: first it puts the value 90 into BX; then it puts the contents of the address whose location is being held in BX into SI. This important distinction is analogous to BASIC's PEEK and POKE (see also Volume 4 Numbers 23 and 24) as shown in Figure 4.

**CHANGING DRIVES** Now that you've seen how easy it is to read the default drive, let's change it. Again, the BASIC program will call on DOS services to do the real work. The necessary assembly language subroutine is shown in Figure 5. The .ASM listing must be assembled (see sidebar "Assembling the Subroutines") in order to produce the DATA bytes that go into the BASIC program, which is listed in Figure 6. At the assembler end, the DOS


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# ASSEMBLING THE SUBROUTINES

In order to translate assembly language mnemonics (source code) into the appropriate bytes of data (machine code), an assembler of some type is always needed. DEBUG comes for free, but it doesn't allow the use of labels. Consequently, when you use DEBUG, you have to guess at the target addresses of jumps and calls, then perform a "second pass" to fill in the final figures manually. The Macro Assembler does allow the use of labels, but besides having to purchase it, you'll also have to add extra lines to the source code to accommodate its conventions.

Either way, you'll need an ASCII text editor to create the programs. I prefer Borland's *SideKick* because it is always on tap: when the assembler finds an error, I don't have to reload an editor program each time. Besides, *SideKick*'s export facility will send the text directly into DEBUG.

**DEBUG** Let's step through a DEBUG session that assembles a program I call UPS as a sample. The fully commented assembler version is shown in Figure A, for reference. UPS simply converts any string into uppercase. It's short enough to keep us from getting bogged down with a lot of extra details, but it also contains a few jumps.

The simplest approach is to assemble the routine as if it were a standalone .COM program. Of course it's not, so don't try to run it from the DOS prompt!

A .COM program begins at address 100h within whatever segment it happens to be when it runs. DEBUG knows this and will begin assembling at this address automatically, unless you tell it otherwise. There's nothing wrong with 100h of course, I just mention it so you'll understand why the program doesn't begin at address zero.

To use DEBUG effectively, you will need to learn five key commands: A (assemble), U (unassemble), N (name), W (write), and RCX (register CX). We'll get to that last one in a moment.

Start DEBUG by typing its name, then at the dash prompt press an A followed by Enter. DEBUG will respond with a four-digit segment number (which varies from one PC to another and is irrelevant to our purpose here), followed by a colon and the offset address 0100. (Pressing A alone does not always begin assembling at address 100h, but since we just started DEBUG, DEBUG will assume that's what we wanted.) Now, as shown in Figure A, type each instruction followed by Enter, and DEBUG will provide the subsequent addresses.

```
-a
####:0100 push bp
####:0101 mov bp,sp
####:0103 mov si,[bp+6]
####:0106 mov bl,[si]
####:0108 mov bh,0
####:010A mov si,[si+1]
####:010D dec bx
####:010E js
```

We've now come to the point in the assembler code where the program must jump ahead if the Sign Flag is set. But how can we know where to tell it to jump to? We can't, so we'll simply have to make up a dummy address value. Since the current address is 10E, let's use 130 as a guess.

```
####:010E js 130
####:0110 mov al,[bx+si]
####:0112 cmp al, 61
####:0114 jb
```

Here's another jump instruction that needs an address, only this time it's a backwards jump, so the address can be found by looking at what was already entered. The earlier instruction DEC BX was at address 10D, so we know that this will be correct. Also, notice how the hex equivalent was required instead of a quoted "a". DEBUG does allow quoted strings under some circumstances, but it won't accept them here.

■ The simplest approach is to assemble the routine as if it were a standalone .COM program. It's not, so don't try to run it from the DOS prompt!

```
####:0114 jb 10d
####:0116 cmp al, 7a
####:0118 ja 10d
####:011A and al,5f
####:011C mov [bx+si],al
####:011E jmp 10d
####:0120 pop bp
####:0121 retf 2
####:0124
-
```

```
      ;-----UPS.ASM

      Pueh BP             ;eeve BP for BASIC
      Mov  BP, SP         ;get eteck eddreee
      Mov  SI, [BP+6]     ;put deecriptor eddrees into SI
      Mov  BL, [SI]       ;put length of etring into BL
      Mov  BH, 0          ;muet cleer BH to use BX below
      Mov  SI, [SI+1]     ;put eddrese of etring into SI
Next: Dec  BX             ;point to previoue cherscter
      JS   Exit           ;we paeeed zero, sll done
      Mov  AL, [BX+SI]    ;put the current cher into AL
      Cmp  AL, 'e'        ;ie it lees then "e"?
      JB   Next           ;yee, go on to the next one
      Cmp  AL, 'z'        ;ie it greeter thsn "z"?
      JA   Next           ;yee, ekip it
      And  AL, 5Fh        ;cleer the "upper ceee" bit
      Mov  [BX+SI], AL    ;poke cher back into the etring
      Jmp  Next           ;do the next one
Exit: Pop  BP             ;restore BP for BASIC
      Ret  2              ;exit diecerding string eddrees
```

**Figure A:** *The commented assembler program for UPS.*

Once the last instruction has been typed, press Enter alone to get back to the dash prompt. If you look at the code you just entered, you will see that the target of the earlier jump should have been to address 120 rather than 130. The final step will be to go back and patch that one instruction.

```
-a10e
####:010E js 120
####:0110
-
```

Now unassemble the entire program, and admire your work.

```
-e100 123
####:0100 55              PUSH    BP
####:0101 89E5            MOV     BP,SP
####:0103 8B7606          MOV     SI,[BP+06]
####:0106 8A1C            MOV     BL,[BX]
####:0108 B700            MOV     BH,00
####:010A 8B7401          MOV     SI,[SI+01]
####:010D 4E              DEC     SI
####:010E 7810            JS      0120
####:0110 8A80            MOV     AL,[BX+SI]
####:0112 3C61            CMP     AL,61
####:0114 72F7            JB      010D
####:0116 3C7A            CMP     AL,7A
####:0118 77F3            JA      010D
####:011A 245F            AND     AL,5F
####:011C 8800            MOV     [BX+SI],AL
####:011E EBED            JMP     010D
####:0120 5D              POP     BP
####:0121 CA0200          RETF    0002
-
```

The hex bytes between the addresses and the unassembled instructions represent the actual binary code that the 8088 will execute when UPS is run. Now it's up to you to write them down (or import them into *SideKick*) and add them as data statements in a program, as shown in Figure B.

If you prefer to save the program as a disk file and read it into a string, you should save it on a disk instead. To do this you must tell DEBUG the name of the program, and how long it is.

The easiest way to determine the length is to take the address that comes up just after the last code instruction and subtract 100h from that. Doing this tells us that the code is 24h bytes long.

DEBUG keeps track of a program's length in its CX register, so we'll put the number 24h there. Enter the command RCX as shown, and DEBUG will report the current contents of CX, a colon, and allow you to enter a new value.

```
-rcx
CX 0000
: 24
```

Now the name of the program must be given using the N command.

```
-nups.bin
```

or

```
-nb:ups.bin
```

The final step is to enter a W (for write), and DEBUG will take the 24h bytes starting at address 100h and write them to the disk, using the name you specified.

**MASM** The Macro Assembler is considerably easier to use, especially as programs become larger and use more labels. Also, using DEBUG is clumsy when inserting or removing instructions in the middle of a program, though it can be done.

Since MASM takes a text file as input, making changes is considerably easier. The only drawback is that MASM requires you to give it additional information about the makeup of your program. Further, it doesn't create programs that you can use directly. After a program is assembled with MASM, it must be LINKed, then converted with EXE2BIN. That's sometimes a high price to pay for being able to use labels.

■ The Macro Assembler is considerably easier to use, especially as programs become larger and use more labels, but doesn't create programs you can use directly.

The minimum syntax for creating a program for MASM to assemble is shown below. As you can see, any segments that are used must be identified, and sections of code must be labeled as procedures, showing their beginning and end. Since the programs will eventually be converted to a pseudo .COM format, the instruction ORG 100h, which identifies a program's origin (starting address), should also be included.

```
Code        Segment
            Assume CS:Code, DS:Code
Ups         Proc   Far
            Org    100h

Begin:      Peek   BP
            Mov    BP,SP
            .
            .
            .

Exit:       Pop    BP
            Ret    2

Ups         Endp
Code        Ends
            End    Begin
```

—Ethan Winer

```
100 '********** Ups.Bas
110 '
120 UPS$ = SPACE$(36)
130 FOR X = 1 TO 36
140     READ BYTE$
150     MID$(UPS$, X, 1) = CHR$(VAL("&H" + BYTE$))
160 NEXT
170 '
180 PRINT "Enter a string to be converted to upper case: ";:LINE INPUT X$
190 IF X$ = "" THEN END
200 '
210 X = VARPTR(UPS$)
220 UPS = PEEK(X+1) + 256*PEEK(X+2)
230 CALL UPS(X$)
240 PRINT : PRINT X$ : PRINT : PRINT : GOTO 180
250 '
260 DATA 55, 89, E5, 8B, 76, 06, 8A, 1C, B7, 00
270 DATA 8B, 74, 01, 4E, 78, 10, 8A, 80, 3C, 61
280 DATA 72, F7, 3C, 7A, 77, F3, 24, 5F, 88, 80
290 DATA EB, ED, 5D, CA, 02, 00
```

**Figure B:** *UPS.BAS uses the assembled subroutine code as data statements.*

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## ■ PC LAB NOTES

```
' Push BP              ;save BP before changing it
  Mov  BP, SP          ;get address of stack
  Mov  SI, [BP+6]      ;get address of DRIVE%
  Mov  DL, [SI]        ;put the value of DRIVE% into DL
  Sub  DL, 65          ;subtract 65 to accommodate DOS
  Mov  AH, 0Eh         ;specify service 0Eh - set drive
  Int  21h             ;call DOS to do it
  Pop  BP              ;restore BP
  Ret  2               ;back to BASIC, clean up stack
```

**Figure 5:** *The assembly language routine for use with Figure 6.*

```
100 '----- SetDrive.Bas
110 '
120 SETDRIVE$ = SPACE$(19)
130 FOR X = 1 TO 19
140     READ BYTE$
150     MID$(SETDRIVE$, X, 1) = CHR$(VAL("&B" + BYTE$))
160 NEXT
170 DRIVE% = 65          'select drive A
180 GOSUB 300
190 END
200 DATA 55              :'Push BP
210 DATA 89, E5          :'Mov  BP, SP
220 DATA 8B, 76, 06      :'Mov  SI, [BP+6]
230 DATA 8A, 14          :'Mov  DL, [SI]
240 DATA 80, EA, 41      :'Sub  DL, 65    (41 hex)
250 DATA B4, 0E          :'Mov  AH, 0Eh
260 DATA CD, 21          :'Int  21h
270 DATA 5D              :'Pop  BP
280 DATA CA, 02, 00      :'Ret  2
290 '
300 X = VARPTR(SETDRIVE$)
310 SETDRIVE = PEEK(X+1) + 256 * PEEK(X+2)
320 CALL SETDRIVE(DRIVE%)
330 RETURN
```

**Figure 6:** *SETDRIVE.BAS incorporates the assembler routine in Figure 5 as data statements.*

■ For the benefit of the BASIC calling program, SetDrive will accept as input integer values beginning with 65 (“A”).

service to set a new drive is specified by first putting the number 15 (0Eh) into AH, a drive identifier into DL, and then calling interrupt 21h. As with GetDrive, this DOS service also uses 0 to indicate drive A:, 1 to indicate drive B:, etc., though again, for the benefit of the BASIC calling program, SetDrive will accept as input integer values beginning with 65 (“A” in ASCII). In the BASIC program, to make drive C: the new default drive, you could simply replace line 170 with the alternative line

```
DRIVE% = ASC("C")
```

(Incidentally, you'll notice that in order to keep these programs simple and to the point, error checking is either minimal or nonexistent. This means, for example, that if someone using your programs attempts to set the drive to “T” on a two-floppy system, DOS will ignore the request and you'll have no way of knowing it. The best solution for SetDrive is to follow it immediately with a call to GetDrive, but using a different variable name. This way, if the two are different, you'll know that SetDrive didn't work.)

The six programs included in the first part of this two-part series have been designed primarily to illustrate techniques. In the next issue, we'll consider some more obviously practical assembler subroutines for your BASIC programs. PC

*Ethan Winer, an independent consultant, is the head of Crescent Software.*

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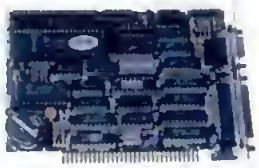

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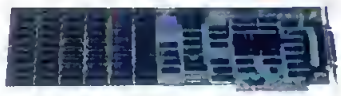

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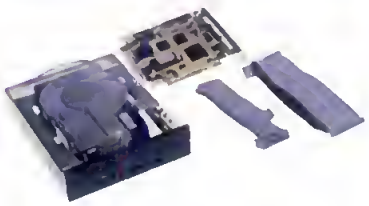

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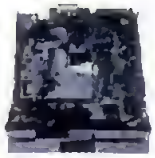

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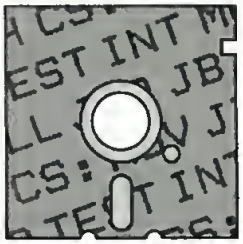
# RETROFITTING A DOS SYSTEM



*If you've ever formatted a floppy disk without the DOS system files and later needed them on the disk, here's the utility to bail you out.*

Every time you get out a new floppy disk, you face the choice of whether to format it with or without the DOS system files. Having the system on a disk is often handy, especially at boot time or when the transient portion of COMMAND.COM gets overlayed. But space is precious on a 360K disk, and the two hidden system files, together with the command processor COMMAND.COM, eat up almost 40K of that space in DOS 2.1, 68K in DOS 3.2.

Inevitably, you occasionally leave off the system files only to wish later that you hadn't.The DOS SYS command doesn't help at this point, since it can add a system only if the disk is blank or if certain critical areas of the disk were initially reserved by using the FORMAT/B option. Of course, if you'd had the foresight to reserve the space, you'd have installed the system to begin with. (The /B switch was included with DOS simply so that non-IBM software vendors, who could not legally sell disks with copyrighted system files included, could reserve room for users to add the system after purchase.) Usually, your only recourse is to format a fresh disk with FORMAT/S and copy everything from the old disk onto the new one.

DISKPREP.COM provides a better solution. DISKPREP rearranges the data clusters, the file allocation table, and the directory of a nonsystem disk so that the SYS command will successfully add the system even if some of the disk files presently occupy territory needed by the system files. It also lets you delete existing system files and replace them with more-current ones. It's a useful addition to anyone's toolbox, and understanding how it operates provides a working education on the way DOS structures and manages information on disk media.

**OBTAINING DISKPREP** The assembler source code for DISKPREP is shown in Figure 1, and a BASIC program that will create the .COM version for you is contained in Figure 2. The accompanying

```
code            segment para public 'code'
                assume cs:code,ds:code,es:code
                org 100h
begin:          jmp prep                    ;skip data area
;
copy_right      db 13,10,'Copyright 1986 Giff-Davis Publishing Co.',13,10,'$'
errmsg1         db 13,10,'Invalid Drive Specifier',13,10,'$'
errmsg2         db 13,10,'Illegal Disk Format',13,10,'$'
errmsg3         db 13,10,'Disk Read Error',13,10,'$'
errmsg6         db 13,10,'Disk Write Error',13,10,'$'
errmsg5         db 13,10,'Insufficient Space in Disk Directory',13,10,'$'
errmsg6         db 13,10,'Insufficient Disk Space',13,10,'$'
errmsg7         db 13,10,'Allocation Chain Error',13,10,'$'
errmsg8         db 13,10,'Cannot Delete System Files',13,10,'$'
errmsg9         db 13,10,'Bad Sector in System Area',13,10,'$'
msg1    db 13,10,'System Prep Completed',13,10,'$'
msg2    db 13,10,'System Already Installed - Delete Old System (Y/N)?',13,10,'$'
msg3    db 13,10,'Execution Aborted',13,10,'$'
;
last_cluster        dw 41           ;last available cluster found
sec_per_cluster     dw ?            ;number of sectors per cluster
clusters            dw ?            ;total number of data clusters on disk
DIR_entries         dw ?            ;maximum number of directory entries
DIR_sectors         dw ?            ;number of sectors used for directory
FAT_sectors         dw ?            ;number of sectors used for one copy of the FAT
FAT_entry           dw ?            ;temporary storage for any FAT entry
drive               db ?            ;current disk drive
format_table    dw 64,4,2               ;S-9 disk format parameters
                dw 112,7,2              ;D-9   "    "      "
                dw 64,4,1               ;S-8   "    "      "
                dw 112,7,1              ;D-8   "    "      "
system_id       db 'IBMBIO',32,32,'COM' ;text of system file IBMBIO.COM
ibmbio          db 'B:IBMBIO.COM',0     ;ASCIIZ string for DOS file functions
ibmdos          db 'B:IBMDOS.COM',0     ;  "    "    "   "   "    "
cbuffer     dw offset endprog       ;pointer to buffer area for cluster transfers
FAT_data    dw offset endprog + 1024 ;pointer to area where FAT image is stored
DIR_data    dw offset endprog + 2048 ;pointer to area where DIR image is stored
;
prep            proc near               ;start of main program
;
;Parse the command line for a drive specifier. If none, use default drive.
;
                cld                     ;clear DF for string operations
                mov si,80h              ;point si to start of command line
                lodsb                   ;get number of characters entered
                cmp al,1
                jbe prep1               ;yes, then use default drive
                inc si                  ;skip first delimiter
                lodsb                   ;get first character (drive specifier)
                and al,0DFh             ;capitalize it
```

*(continues)*

**Figure 1:** *The assembly language program for creating DISKPREP.COM.*

sidebar contains instructions for downloading these files (or the assembled .COM file) by modem from the PC Magazine Interactive Reader Service.

**DISKPREP IN ACTION** Transforming a nonsystem disk into a system disk is a three-step process that begins by preparing the disk with DISKPREP. The syntax for DISKPREP is simply

```
DISKPREP [d:]
```

where *d:* is an optional drive specifier for use if the target disk is not in the default drive. Up to 44K of free disk space, depending on the version of DOS you use, are required for SYS.COM to add the two hidden system files. In addition, at least two entries in your disk's root directory must be unused.

■ Transforming a nonsystem disk is a three-step process that begins by preparing the disk with DISKPREP.

If DISKPREP finds that your disk has less than adequate space, it will abort with a message indicating as much. If that happens, delete one or more files to free up some room and try again. If the disk you're prepping is already system formatted, the program will display the message "System already installed - Delete old system (Y/N)?" and await your keypress. If you respond with a Y, the old system will be erased; if you answer N, execution will terminate harmlessly. In the unlikely event that DISKPREP encounters an error condition such as a lost cluster when traversing an allocation chain, it will abort with an "Allocation chain error" message and leave you to your own devices. That's a good time to pull out CHKDSK or one of several commercially available disk maintenance utilities and attempt to salvage the damaged data. Another possible but unlikely occurrence is that DISKPREP will

```
                sub al,'A'              ;convert ASCII to drive number
                cmp el,1                ;is drive specified either A: or B:?
                jbe prep2               ;yes, then parsing is finished
                les dx,srrmsg1          ;no, then specifier is illegal
                jmp error_exit          ;load error message address and abort
prep1:          mov ah,19h              ;DOS function 19h - get current drive
                int 21h                 ;get default drive number
                cmp el,1                ;is it drive A: or B:?
                jbe prep2               ;yes, then skip error routine
                lea dx,srrmsg1          ;no, then get message address and abort
;
;Program execution is routed here when a critical error condition is detected.
;
error_exit:     mov ah,9                ;DOS function number - print string
                int 21h                 ;print error message
                mov ah,14               ;ROM BIOS teletype routine function number
                mov al,7                ;ASCII code for beep
                int 10h                 ;'print' the beep
error1:         mov ah,4Ch              ;DOS function number - exit
                mov al,1                ;set ERRORLEVEL return code to 1
                int 21h                 ;terminate program on error
;
; Check the format of the disk to verify that it's a 48-track diskette
; (8 or 9 sectors per track, one or two sides).
; Store information pertaining to the disk format.
;
prep2:          mov drive,el            ;save current drive ID
                mov dl,al               ;get drive identifier in DL
                inc dl                  ;adjust drive ID for DOS function call
                push ds                 ;save segment register
                mov ah,1Ch              ;DOS function number-get FAT information
                int 21h                 ;get pointer to FAT ID byte
                mov cl,[bx]             ;store ID byte in CL
                pop ds                  ;restore DS
                cmp cl,0FCh             ;ID byte greater than or equal to FCh?
                jae prep2a              ;yes, then format is OK
                les ds,errmsg2          ;no, then format is invalid
                jmp error_exit          ;abort on error
prep2a:         cbw                     ;convert byte in AL to word in AX
                mov sec_per_cluster,ax  ;store number of sectors per cluster
                mov clustere,dx         ;store total number of data clusters
                sub cl,0FCh             ;normalize ID byte by subtracting FCh
                mov al,cl
                mov dl,6
                mul dl                  ;multiply result by 6
                mov bl,al               ;transfer table index in AL to BL
                xor bh,bh               ;convert byte to word
                add bx,offset format_table    ;form address of disk format
                                              ;parameter line
                mov ax,[bx]             ;read number of dir entries from table
                mov DIR_entries,ax      ;save number of entries
                mov ax,[bx+2]           ;read directory length from table
                mov DIR_sectors,ax      ;save directory length
                mov ax,[bx+4]           ;read FAT length from table
                mov FAT_sectors,ax      ;save FAT length
;
;Read root directory and one copy of FAT into memory from the selected drive.
;
prep3:          call read_FAT       ;read in one copy of the File Allocation Table
                jnc prep3a          ;continue if no error on read
                les dx,errmsg3      ;exit if error occurred during read
                jmp error_exit
prep3a:         call read_DIR       ;read in the disk directory
                jnc prep4           ;continue if no error
                les ds,errmsg3      ;otherwise abort
                jmp error_exit
;
;Determine if the disk is already system formatted by seeing if the first
;file in the directory is IBMBIO.COM.
;
prep4:          les si,system_id        ;point SI to 'IBMBIO.COM' text
                mov di,DIR_date         ;point DI to first filename
                mov cx,11               ;11 bytes to check
                repe cmpsb              ;compare the two strings
                jne prep6               ;skip delete routine if no system
;
;Disk already system formatted--see if user wants to delete the system files.
;
                lea dx,msg2             ;get query message address
                mov ah,9                ;DOS function number - print string
                int 21h                 ;print 'Delete System?' message
prep5:          mov ah,0                ;ROM BIOS function number - get keystroke
                int 16h                 ;get user response from keyboard
                and al,0DFh             ;capitalize entry
                cmp el,'Y'              ;was 'Y' pressed?
                je prep5a               ;yes - delete system files
                cmp al,'N'              ;was 'N' pressed?
                jne prep5               ;no, then get another keystroke
                lea dx,msg3             ;get abort message address
```

*(Figure 1 continues)*

```
                mov ah,9                ;print 'Execution Aborted' meeeege
                int 21h
                jmp error1              ;exit with ERRORLEVEL set to 1
;
;Delete syatem filee - chenge file ettributae to 0 (eliminating reed-only bit)
;befora using DOS delete function.
;
prep5e:         cmp driva,1             ;ie B: tha currant drive?
                je prep5b               ;yee, then continue
                dec ibmbio              ;no, set ASCIIZ drive deeignetore to A:
                dec ibmdoe
prep5b:         lee dx,ibmbio           ;change IBMBIO.COM file ettribute for deletion
                mov ah,43h              ;DOS function number - chenge ettribute
                mov cx,0                ;new file ettribute
                mov al,1                ;epecify thet ettribute ia to be chenged
                int 21h                 ;xero IBMBIO.COM file ettribute
                jc prep5c               ;eait on error if unauccasaful
                lee dx,ibmdoe           ;do the eame for IBMDOS.COM
                mov ah,43h
                mov cx,0
                mov al,1
                int 21h
                jc prep5c
                lee dx,ibmbio           ;now delete IBMBIO.COM
                mov ah,41h              ;DOS function number - delate fila
                int 21h                 ;dalete tha fila
                jc prep5c               ;eait on error if uneuccesaful
                lea dx,ibmdoe           ;do the eame for IBMDOS.COM
                mov ah,41h
                int 21h
                jc prep5c
                jmp prep3               ;rereed FAT and directory
prep5c:         lee dx,errmeg8          ;filee cannot be deleted - abort
                jmp arror_exit
;
;Check thet tha diak hae edequete frea epace befora continuing.
;
prep6:          mov dl,drive            ;get drive in DL
                inc dl                  ;edjust drive ID for DOS function call
                mov ah,36h              ;DOS function number - get free epece
                int 21h                 ;get number of cluetere thet ere free
                mov ex,sec_per_clueter  ;get sectore per clueter
                mul hx                  ;multiply to get frea sectore
                cmp ea,100              ;at leeet 100 sectore (50K) frae?
                jaa prap7               ;yee, then continue
                lee dx,errmeg6          ;no, than load error meesage eddreee
                jmp error_exit          ;exit
;
;Check firet two directory entriee to see whether sech ie used or aveilable.
;For sech one not eveileble, tranefer it to the firet eveilable epace.
;
prep7:          mov ei,OIR_date         ;point SI to directory image
                cmp byte ptr [ei],0     ;ie the first entry eveilable?
                ja prep9                ;yae, than goto next entry
                cmp byte ptr [ei],0E5h  ;ereeed fila?
                jne prep7e              ;no, then move it
                mov byte ptr [ai],0     ;mark entry ae 'Never Ueed'
                jmp prep9               ;jump to next entry
prep7e:         mov dx,2                ;entry ie occupied
                call find_entry         ;find first eveilable directory entry
                jnc prep8               ;entry found - continue
                lee dx,errmeg5   ;no space in dir - load error meeaege addreee
                jmp error_exit          ;ebort
prep8:          mov ex,0
                call move_entry         ;copy antry 0 into first availeble slot
prep9:          mov ei,DIR_data         ;check second entry for aveilehility
                edd ei,32               ;point SI to eecond entry
                cmp byte ptr [ei],0     ;first byte xero?
                je prep13               ;yee, then it'e evailable
                cmp byta ptr [ei],0E5h  ;ereeed file?
                jne prep9e              ;no, then move it
                mov byte ptr [ei],0     ;merk entry ee 'Never Used'
                jmp prap13              ;continue
prep9e:         mov dx,2                ;not evailehle
                call find_entry         ;find firat evailabla entry
                jnc prep10              ;continua if empty slot found
                lea dx,errmeg5          ;ebort if not
                jmp error_aait
prep10:         mov ex,1
                call move_entry         ;copy entry and merk old one eveileble
;
;Copy sech of the first forty cluetere currently in use to cluetere beyond the
;firet forty and edjuet the correeponding FAT entriee eccordingly.
;
prep13:         mov cx,40               ;check 40 cluatare
                mov da,2                ;etert checking et clueter 2
prep14:         pueh cx                 ;eeve loop counter
                call get_FAT_entry      ;get FAT entry for current clueter
                cmp ex,0                ;ie it eveilabla?
                je prep17               ;yee, then proceed to next clueter
```

*(Figure 1 continues)*

find one or more bad sectors in the area of the disk where the system is to be installed. If that happens, the message "Bad sector in system area" is issued and execution is aborted.

Once DISKPREP has finished, you use the SYS.COM program supplied with DOS to install the system on the disk. This simply involves copying a pair of hidden system files from one disk to another and ensuring that they occupy certain areas in the directory and the data space. Fortunately, SYS takes care of that task. SYS's syntax is almost identical to that of DISKPREP and is detailed in your DOS manual. Note that if you try to use the disk after DISKPREPing but before SYStemizing,

■ The three steps involved in the SYStemization process are natural candidates for a batch file.

DOS will think that it's dealing with a newly formatted disk and will respond to a DIR request with a "File not found" message. Likewise, using CHKDSK to analyze a disk that has been prepared but not yet SYStemized may produce some strange results. Have faith: as soon as SYS.COM is run, your files will reappear intact and the disk will be ready for use again.

The final step in transforming your disk into a complete system disk is to copy the file COMMAND.COM from your DOS disk to the target disk. This is necessary because, unlike FORMAT/S, SYS does not automatically add COMMAND.COM for you. You simply use the DOS COPY command to perform the transfer, just as you would use it to copy any other file from one disk to another.

The three steps involved in the SYStemization process are natural candidates for a batch file, and to facilitate just that use, DISKPREP terminates with a return code that can be read by the conditional pa-

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rameter ERRORLEVEL. If the disk prepping process was successful, ERRORLEVEL is set to zero. If the prepping process was not successful for any reason, DISKPREP executes its normal abort routine complete with a message revealing the nature of the error and sets the ERRORLEVEL return code to 1. A suitable batch file (you might call it SYSTEM.BAT) is listed below. It assumes that the program disk is in the default drive and that the target disk is in drive B:

```
DISKPREP B:
IF ERRORLEVEL 1 GOTO END
SYS B:
COPY COMMAND.COM B:
:END
```

DISKPREP works on floppy disks of the 40-track variety with one or two sides and eight or nine sectors per track. This covers all four 5¼-inch disk formats supported by versions of DOS prior to 3.0 but excludes hard disks, high-capacity (1.2-meg) floppies like those used by the AT, and the 3½-inch disk cartridges used by a number of laptop portables. Attempting to process one of the latter types of disks isn't harmful: the program will quickly recognize the unsupported format and abort with an "Illegal disk format" message. If reader demand is sufficient, I'll work out the code for these formats later.

■ If the prepping process was not successful, DISKPREP aborts it with a message revealing the nature of the error.

Two cautions are in order. First, do not use DISKPREP on a disk that contains subdirectories. While sometimes subdirectories will not interfere with the reallocation process, at other times their presence may cause an "Allocation chain error" message, prevent existing system files from being deleted (resulting in the error message "Cannot delete system files"), or

```
                cmp ee,0FF0h            ;ie FAT entry leee then FF0h?
                jb prep14e              ;yee, then move clueter
                cmp ee,0FF7h            ;ie it greeter then FF7h?
                je prep14e              ;yee, then move clueter
                pop ce                  ;bad clueter - clean up eteck
                lee de,errmeg9          ;load error meesage eddreee
                jmp error_eeit          ;ebort
prep14e:        mov FAT_entry,ee        ;eeve FAT entry for leter
                mov ee,leet_cluster     ;get number of leet eveilehle clueter
                inc ee                  ;increment to the neet one to begin eeerch
                mov he,0
                cell find_clueter       ;find firet clueter with FAT entry of eero
                mov leet_cluster,ee     ;etore clueter number juet found
                cell move_cluster       ;copy the old clueter into the new
                jnc prep15              ;continue if no error in diek I/O
                pop cx                  ;on error, cleen up eteck and eeit
                jmp error_eeit
prep15:         mov ee,FAT_entry        ;retrieve the FAT entry for the old cluster
                pueh dx                 ;eeve the old clueter number
                mov de,leet_clueter     ;terget the new clueter
                cell put_FAT_entry      ;put the old FAT entry into the new one
                pop de                  ;reetore old clueter number
                mov ee,0                ;merk the old clueter eveilable...
                call put_FAT_entry      ;...by setting ite FAT entry to eero
                mov he,de               ;get old clueter number in BX for seerch
                mov ee,2                ;etert seerch et clueter 2
                cell find_cluster       ;find FAT entry thet referenced old cluster
                jnc prep16              ;if found, then continue
                call seerch_DIR         ;if not, then look in the directory
                jnc prep15e             ;if found, then continue
                pop ce                  ;cleen up eteck
                lee de,errmeg7          ;error - loet clueter or eubdir encountered
                jmp error_eeit          ;ebort on error
prep15e:        mov ee,leet_clueter     ;get new clueter number
                mov [be],ee             ;replace the sterting clueter directory entry
                jmp prep17              ;ekip forwerd
prep16:         pueh dx                 ;eeve current clueter number
                mov de,ee               ;change FAT entry thet formerly referenced
                mov ee,leet_clueter     ;tbe old clueter to reference new one
                call put_FAT_entry
                pop de                  ;reetore current clueter number
prep17:         pop ce                  ;reetore count of cluetere checked
                inc de                  ;indee to next sequential clueter
                loop prep14             ;loop until the firet 40 ere cleer
;
;Write two copiee of the File Allocation Teble and one copy of the diek
;directory back to diek, then eeit.
;
prep17e:        call write_FAT          ;write two copiee of the FAT
                jnc prep18              ;continue if no error on write
                lea de,errmeg4          ;ebort on error
                jmp error_exit
prep18:         cell write_DIR          ;write the directory to diek
                jnc prep19              ;check error etetue
                lee dx,errmeg4          ;ebort on write error
                jmp error_eeit
prep19:         lee dx,megl             ;meeeege eddreee for eucceeeful completion
                mov ah,9                ;DOS dieplay string function
                int 21h                 ;print meesage
                mov ah,4Ch              ;DOS function number - eeit
                mov el,0                ;eet ERRORLEVEL return code to 0
                int 21h                 ;eeit program
prep            endp
;
;---------------------------------------------------------------------------
;GET_FAT_ENTRY routine returns the FAT entry for the indicated clueter.
;Entry:  OX - clueter number (2-XXX)    | Eeit:  AX - FAT entry
;---------------------------------------------------------------------------
get_FAT_entry proc neer
                mov ee,3                ;multiply clueter number by 3
                pueh dx                 ;eeve clueter number
                mul de                  ;multiply
                pop de                  ;reetore clueter number
                shr ee,1                ;divide by 2 to obtein offset into FAT
                mov be,ee               ;trenefer reeult to be
                edd he,FAT_dete         ;meke eddreee reletive to code segment
                mov ee,[be]             ;get word et calculated eddreee
                teet dx,1               ;ie clueter number odd or even?
                je getfl                ;even, then jump
                mov cl,4                ;number ie odd, so keep upper 12 hite of word
                ehr ee,cl               ;hy shifting right 4 hite
                ret                     ;done - entry in AX
getfl:          end ee,0FFFb            ;even number, then meek off upper 4 hite
                ret                     ;done - entry in AX
get_FAT_entry endp
;
;---------------------------------------------------------------------------
;PUT_FAT_ENTRY plecee the deeignated number into the FAT entry for the named
;clueter.  Entry:  DX - cluster number (2-XXX)
;                  AX - entry
;---------------------------------------------------------------------------
```

*(Figure 1 continues)*

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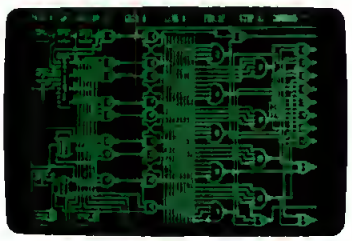

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CIRCLE 497 ON READER SERVICE CARD

## ■ PROGRAMMING/UTILITIES

```
put_FAT_entry proc neer
              pueh ex                   ;save new FAT entry
              pueh dx                   ;seve clueter numbsr
              mov ex,3                  ;multiply cluster by 3
              mul dx
              pop dx                    ;reetore clueter number
              shr ex,1                  ;divide by 2
              mov bx,ax                 ;trenefer to BX
              edd bx,FAT_date           ;complete offset eddreee of FAT entry
              pop ex                    ;reetore FAT entry
              teet dx,1                 ;is ths cluster odd or evsn?
              je putf1                  ;even, then jump forwerd
              mov cl,4                  ;odd - shift entry 4 hite left
              ehl ex,cl
              end word ptr [hx],0Fh     ;xero upper 12 hits of word
              or [bx],ex                ;inetell new FAT entry
              ret                       ;done - exit
putf1:        end [hx],0F000h           ;even - xero lower 12 hite
              or [bx],ex                ;plece entry in lower 12 hits
              rst                       ;done - exit
put_FAT_entry endp
;
;-------------------------------------------------------------------------
;The following four routines write end reed complete copise of the FAT and the
;diek directory to end from the selected drive.
;-------------------------------------------------------------------------
reed_FAT      proc neer                 ;reed one copy of the FAT into memory
              mov al,drive              ;define drive
              mov dx,1                  ;etert et sector 1
              mov cx,FAT_sectore        ;eet oumber of sectore
              mov bx,FAT_date           ;define buffer eddreee
              int 25h                   ;DOS ehsolute sector rsed
              pop dx                    ;clean flege off eteck
              ret
reed_FAT      endp
;
reed_DIR      proc neer                 ;reed one copy of directory into memory
              mov el,drive              ;define drive
              mov dx,FAT_sectore        ;get number of sectors per FAT
              ehl dx,1                  ;douhle it for two copiee of the FAT
              inc dx                    ;directory eterte in next sector
              mov cx,DIR_sectore        ;number of sectore to reed
              mov bx,DIR_date           ;addreee of etorege buffer
              int 25h                   ;reed sectore
              pop dx                    ;cleen up the eteck before exit
              ret
reed_DIR      endp
;
write_FAT     proc neer                 ;write two copiee of the FAT to diek
              mov al,drive              ;define drive
              mov dx,1                  ;begin et sector 1
              mov cx,FAT_sectore        ;get number of sectore per FAT
              mov bx,FAT_data           ;define buffer eddreee
              int 26h                   ;DOS ebeolute sector write
              pop dx                    ;cleen up eteck
              jc wfet1                  ;exit on write error
              mov al,drive              ;repeet proceee for second copy of FAT
              mov dx,1
              mov cx,FAT_sectore
              edd dx,cx                 ;etert second FAT aftsr first one on diek
              mov bx,FAT_dete
              int 26h
              pop dx
wfet1:        ret
write_FAT     endp
;
write_DIR     proc neer           ;write diek directory imege in memory to diek
              mov al,drive              ;define drive
              mov dx,FAT_sectore        ;get number of sectore per FAT
              shl dx,1                  ;double it for two copiee
              inc dx                    ;directory eterts in next sector
              mov cx,DIR_sectore        ;number of sectore to reed
              mov hx,DIR_date           ;eddreee of date to be written
              int 26h                   ;write sectore
              pop dx                    ;cleao up eteck
              ret
writs_DIR     endp
;
;-------------------------------------------------------------------------
;FIND_ENTRY seerchee thru the imags of the diek directory stored in memory and
;finde the firet eveilable directory entry.
;Entry:  DX - eterting entry (0-XXX)   | Exit:  DX - firet eveilehle entry
;                                      |        CF - clear: eveil. entry found
;                                      |             eet:   not found
;-------------------------------------------------------------------------
find_entry    proc neer
              mov cx,DIR_entriee        ;set maximum number of triee in CX
              euh cx,dx
              pueh cx                   ;save count value
              mov bx,dx                 ;get eterting entry number io BX
              mov cl,5                  ;multiply BX by 32
```

*(Figure 1 continues)*

result in a damaged file allocation table. Fortunately, there's little use for tree-structured directories on a floppy, anyway, so this limitation is not too serious. Second, it's risky to try to prep a copy-protected disk, since many copy protection schemes alter the disk format. DISKPREP should work with any current release of DOS but may or may not be compatible with future versions.

SYStemizing a disk can be a tricky proposition even for DOS. If you run SYS .COM on a nonsystem disk that isn't empty without first running DISKPREP, SYS will usually respond with a "No room for system on destination disk" message. In some cases, however, SYS may appear to add the files successfully, though you'll find that the disk won't boot even though SYS apparently succeeded. So, check any disk you SYStemize by booting your PC

■ It's risky to try to prep a copy-protected disk, since many copy protection schemes alter the disk format.

with it. If you have a disk with an improperly installed system, DISKPREP can be used to correct it. The program's ability to delete system files works just as well with a faulty system as with one added properly. I have found that even DISKPREP will sometimes fail if you delete a system installed under DOS 3.1 and resystemize with the DOS 2.1 version of SYS. If you encounter this problem, don't despair: DISKPREPing the disk a second time and running DOS 3.1 SYS will restore it unharmed. There seem to be no problems with replacing system files with a system of the same version of DOS or later, which is the normal requirement.

**DOS FILE MANAGEMENT** One task of an operating system is organizing information on disks so that each individual file is allotted its own space and cannot be ac-

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cidentally overwritten by another file or otherwise destroyed. Since some knowledge of the logical structure of a disk is essential to understanding the workings of DOS, let me begin by hitting the high points of disk organization. Keep in mind that our discussion pertains only to floppy disks and not to fixed disks.

Versions of DOS through 2.1 supported only four different types of floppy disks: single-sided with eight or nine sectors per track (S-8 and S-9, respectively), and double-sided with eight or nine sectors per track (D-8 and D-9). Each disk comes from the manufacturer physically divided into 40 magnetic tracks of storage space, and when we format the disk each track is subdivided into a specified number of 512-byte sectors. A double-sided disk with nine sectors per track (the usual 360K DS/DD disk) has 720 sectors (two sides times 40 tracks per side times nine sectors per track). All but a small portion of this space is available for file storage. The rest is taken up by the disk directory, the boot record, and the heart of DOS's file management system, the file allocation table, better known as the acronym FAT.

■ The smallest unit of disk space that can be allotted to a file or a portion of a file is called a cluster.

The smallest unit of disk space that can be allotted to a file or a portion of a file is a cluster, which is a logical grouping of one or two sectors, depending on the specific format of the disk. On a 360K disk, a cluster comprises two consecutive sectors, and there are 354 clusters (numbered 2 through 355) available for data storage. The number of data clusters that are available for file storage is determined by the overall capacity of the disk and by the length of the directory and file allocation table. Since no unit smaller than one cluster can be allocated, a file only a few bytes in length will tie

```
                shl bx,cl
                add bx,DIR_data          ;complete offset address
                pop cx                   ;restore loop counter
findsnt1:       cmp byte ptr [bx],0      ;is the first byte zero?
                je findent2              ;yes, then it's available
                cmp byte ptr [bx],0E5h   ;is it an erased file?
                je findent2              ;yes, then it's available
                inc dx                   ;not available - check next entry
                add bx,32                ;address of next entry
                loop findsnt1            ;loop back if some remain
                stc                      ;none available - set CF
                ret
findent2:       clc                      ;clear CF to indicate entry found
                ret
find_entry      endp
;
;-------------------------------------------------------------------------
;MOVE_ENTRY routine transfers a directory entry from one space to another and
;sets the old entry to indicate that it's available.
;Entry:  AX - source entry (0-XXX)
;        DX - target entry (0-XXX)
;-------------------------------------------------------------------------
move_entry      proc near
                mov si,ax               ;convert entry number to offset address in SI
                mov cl,5
                shl si,cl
                add si,DIR_data
                mov di,dx               ;do the same for DI
                mov cl,5
                shl di,cl
                add di,DIR_data
                push si                 ;save address of old entry for later
                mov cx,32               ;32 bytes per entry
                rep movsb               ;move all 32 bytes
                pop si                  ;get address of old entry
                mov byte ptr [si],0     ;mark entry as 'Never Used'
                ret
move_entry      endp
;
;-------------------------------------------------------------------------
;FIND_CLUSTER routine finds the first cluster whose FAT entry matches the number
;specified in BX.
;Entry:  AX - starting cluster (2-XXX) | Exit:  AX - first cluster found
;        BX - FAT entry                |        CF - clear: cluster found
;                                      |             set:   not found
;-------------------------------------------------------------------------
find_cluster    proc near
                mov cx,clusters         ;get number of clusters
                add cx,2                ;calculate max number of search loops
                sub cx,ax
                push dx                 ;save DX
                mov dx,ax               ;starting cluster in DX
findcls1:       push cx                 ;save count of clusters checked
                push bx                 ;save FAT entry value
                call get_FAT_entry      ;get FAT entry for designated cluster
                pop bx                  ;restore FAT entry to BX
                pop cx                  ;restore count
                cmp ax,bx               ;is it what we're searching for?
                je findcls2             ;yes, then terminate search
                inc dx                  ;no, then try next cluster
                loop findcls1
                pop dx                  ;restore DX
                stc                     ;set CF to indicate cluster not found
                ret                     ;exit
findcls2:       mov ax,dx               ;put cluster number in AX
                pop dx                  ;restore DX
                clc                     ;clear CF to indicate success
                ret                     ;exit
find_cluster    endp
;
;-------------------------------------------------------------------------
;CLS2SEC routine returns the sector number that corresponds to the cluster
;number input. Entry:  DX - cluster number (2-XXX)  | Exit:  DX - sector number
;-------------------------------------------------------------------------
cls2sec         proc near
                sub dx,2                ;subtract two from the cluster number
                mov ax,sec_per_cluster  ;get number of sectors in each cluster
                mul dx                  ;multiply DX by sectors per cluster
                mov dx,ax               ;get result in DX
                mov ax,FAT_sectors      ;get number of sectors in FAT
                shl ax,1                ;double it for two copies of the FAT
                add dx,ax               ;add FAT sectors
                add dx,DIR_sectors      ;add directory sectors
                inc dx                  ;data starts in next sector
                ret
cls2sec         endp
;
;-------------------------------------------------------------------------
;MOVE_CLUSTER routine copies the contents of the source cluster into the
;target cluster.
```

*(Figure 1 continues)*

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```
;Entry:  DX - source cluster (2-XXX)    | Exit:  CF - clear: no error in disk I/O
;        AX - target cluster (2-XXX)    |              set:   I/O error
;-------------------------------------------------------------------------
move_cluster  proc near
              push dx                   ;save source cluster number
              push ax                   ;save target cluster number
              call cls2sec              ;get sector number of source cluster
              mov cx,sec_per_cluster    ;number of sectors to read
              mov al,drive              ;specify drive
              mov bx,chuffer            ;set data transfer area
              int 25h                   ;DOS sector read
              pop ax                    ;clean up stack
              pop dx                    ;target cluster in DX
              jc movecl                 ;exit on error
              call cls2sec              ;get sector number of target cluster
              mov cx,sec_per_cluster    ;number of sectors to read
              mov al,drive              ;specify drive
              mov bx,cbuffer            ;data transfer area
              int 26h                   ;DOS sector write
              pop ax                    ;clean up stack
              pop dx                    ;restore source cluster
              jc movec2                 ;abort on error
              ret                       ;exit after successful transfer
movecl:       pop dx                    ;clean up stack before exit
              lea dx,errmeg3          ;exit with pointer to 'Read Error' message
              ret
movec2:       lea dx,errmag4            ;exit with 'Write Error' message address
              ret
move_cluster  endp
;
;-------------------------------------------------------------------------
;SEARCH_DIR routine searches each entry in the disk directory image for a
;starting cluster entry that matches the one input in DX.
;Entry: DX - cluster number (2-XXX) | Exit: BX - addr of starting cluster word
;                                   |         CF - clear: match found
;                                   |              set:   not found
;-------------------------------------------------------------------------
search_DIR    proc near
              mov bx,DIR_data           ;get starting address of directory image
              add bx,00               ;starting cluster offset - 3rd directory entry
              mov cx,DIR_entries        ;get maximum number of search loops
              sub cx,2                  ;skip first two entries
sdir1:        cmp [bx],dx               ;do the words match for this entry?
              je sdir2                  ;yes, then clear CF and exit
              add bx,32                 ;no, then adjust BX for next entry
              loop sdir1                ;try next entry
              stc                       ;no match found - set CF and exit
              ret
sdir2:        clc                       ;match found - clear CF
              ret
search_DIR    endp
;
andprog       label byte                ;end of program - start of buffer area
;
code          ends
              end begin                                        (Figure 1 ends)
```

```
100 REM -- BASIC PROGRAM TO CREATE diskprep.COM
110 OPEN "diskprep.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I% = 1 TO  176
150     LINESUM% = 0
160     FOR J% = 1 TO 8
170         READ BYTE%
180         CHECKSUM = CHECKSUM + BYTE%
190         LINESUM% = LINESUM% + BYTE%
200         IF (BYTE% < 256) THEN LSET A$ = CHR$(BYTE%)
210         PUT #1
220     NEXT J%
230     READ LINECHECK%
240     IF LINECHECK% <> LINESUM% THEN PRINT "Error in Line";200 + 10 * I%
250 NEXT I%
260 CLOSE
270 IF CHECKSUM = 135660 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,   225,     1,    13,    1E,    67,   111,   112,   772
300 DATA    121,   114,   105,   103,   104,   116,    32,    49,   744
310 DATA     57,    56,    54,    32,    98,   105,   102,   102,   598
320 DATA     45,    68,    97,   116,   105,   115,    32,    88,   660
330 DATA    117,    98,   100,   105,   115,   104,   105,   110,   862
340 DATA    103,    32,    67,   111,    46,    13,    10,    36,   418
350 DATA     13,    10,    73,   110,   110,    87,   1E0,   105,   634
360 DATA    100,    32,    68,   114,   105,   110,   101,    32,   670
370 DATA     83,   112,   101,    99,   105,   102,   105,   101,   888
380 DATA    114,    13,    10,    36,    13,    10,    73,   10E,   377
390 DATA    100,   101,   103,    97,   108,    32,    68,   105,   722
                                                          (continues)
```

**Figure 2:** *A BASIC program that will create DISKPREP.COM.*

up an entire cluster of disk space.

When DOS gets a request to put a new file on a disk, it searches through its list of data clusters looking for those that are unused and can be assigned to the new file. The file is then written to the disk, one sector at a time, and a 32-byte entry is put in the disk directory. The directory entry contains the filename, the file attributes, and such other important parameters as the date and time the file was created. Prior to DOS 3.0, clusters were allocated on a first-come, first-served basis; that is, the search for available clusters started at the very first data cluster and proceeded sequentially until one cluster was assigned for each one needed by the file. Since file deletions usually leave pockets of empty clusters in the midst of a span of used ones, long files on a much-used disk are rarely stored in contiguous sectors. (This is what it means to speak of files as "fragmented.") Later versions of DOS are more selective in choosing clusters, but they still don't necessarily place all clusters belonging to a given file together.

■ The FAT is a table of entries—one for each data cluster—that keeps a record of the status of each cluster.

Obviously, if the operating system is to manage disk space and maintain the integrity of the information stored there, it must have some sort of road map to know which clusters are used by which files in what order. That road map is called a file allocation table. Each FAT occupies either one or two sectors, and it always begins in the second sector, immediately following the boot record. DOS considers this table so important that it keeps two copies on every disk.

The FAT is a table of entries—one for each data cluster—that keeps a record of the status of each cluster. If the FAT entry for a cluster is zero, then that cluster is un-

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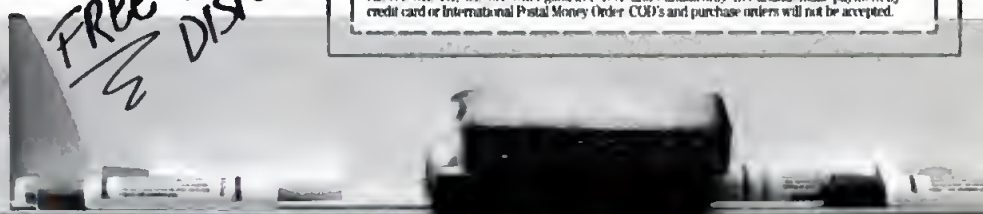

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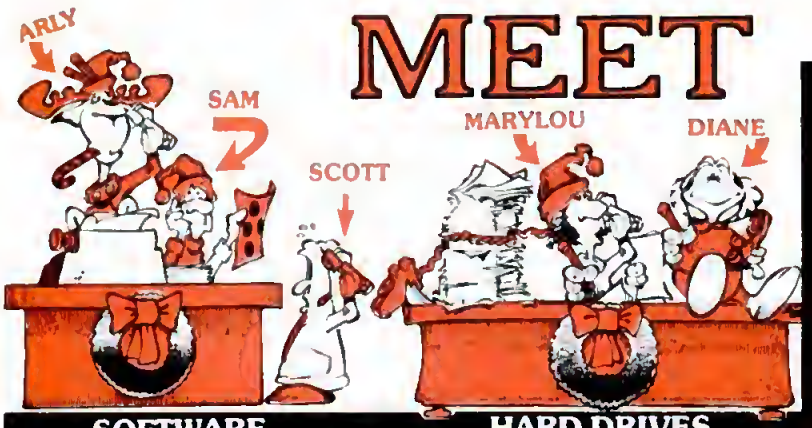


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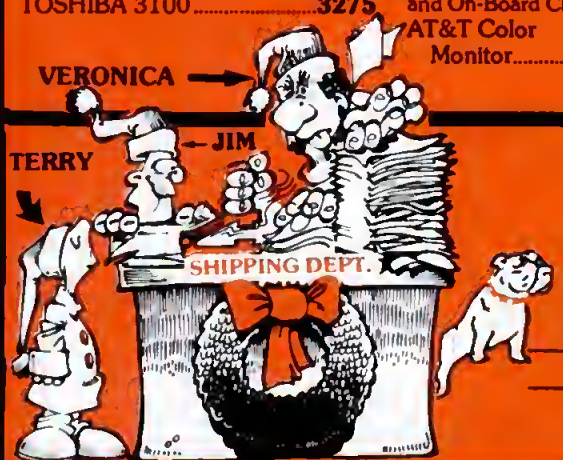


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used and available to be claimed by a new file. If the entry is between FF0 and FF7 hex, inclusive, then that cluster has been reserved by DOS, usually meaning it was marked "bad" during the formatting process. Any other number in an entry means that the cluster is in use and, more important, the number itself indicates the number of the next cluster in the allocation chain.

Suppose, for example, that the operating system wants to find room for a file that will take up three clusters and that a search for available clusters finds that clusters 5, 10, and 11 are the first three currently unused. When the file is saved to disk, DOS will set the FAT entry for cluster number 5 to 10, indicating that cluster 10 holds the next portion of the file. Following the same logic, the FAT entry for cluster number 10 will be 11, and the entry for cluster 11 will be FFFh, which is the number always used to mark the last cluster in the chain. As you see, a chain of data clusters has been mapped in the FAT and the clusters don't have to be contiguous.

■ The *starting* cluster is recorded at offset 26 in the file's directory entry, in the form of a single word.

How does DOS know which cluster is the first in the chain (cluster number 5 in this case)? The *starting* cluster is recorded at offset 26 in the file's directory entry, in the form of a single word stored in low-byte/high-byte fashion. Thus a complete record of storage space allocated to each file is stored in the FAT and in the directory, and, by reading the map, DOS can write, read, delete, and in other ways manipulate files to perform the functions that we commonly require.

Odd though it seems, for reasons of efficient use of disk space each FAT entry is 12 bits in length—halfway between an 8-bit byte and a 16-bit word. Thus two FAT

```
400 DATA  115,  107,   32,   70,  111,  114,  100,   97,  755
410 DATA  116,   13,   10,   36,   13,   10,   68,  105,  371
420 DATA  115,  107,   32,   82,  101,   97,  100,   32,  666
430 DATA   89,  114,  114,  111,  114,   13,   10,   36,  501
440 DATA   13,   10,   68,  105,  115,  107,   32,   87,  537
450 DATA  114,  105,  116,  101,   32,   69,  114,  114,  765
460 DATA  111,  114,   13,   10,   36,   13,   10,   73,  380
470 DATA  110,  115,  117,  102,  102,  105,   99,  105,  855
480 DATA  101,  110,  116,   32,   83,  112,   97,   99,  750
490 DATA  101,   32,  105,  110,   32,   68,  105,  115,  660
500 DATA  107,   32,   68,  105,  114,  101,   99,  116,  742
510 DATA  111,  114,  121,   13,   10,   36,   13,   10,  420
520 DATA   73,  110,  115,  117,  102,  102,  105,   99,  823
530 DATA  105,  101,  110,  110,   32,   68,  105,  115,  752
540 DATA  107,   32,   83,  112,   97,   99,  101,   13,  644
550 DATA   10,   36,   13,   10,   65,  100,  100,  111,  481
560 DATA   99,   97,  116,  105,  111,  110,   32,   67,  737
570 DATA  104,   97,  105,  110,   32,   68,  114,  114,  745
580 DATA  111,  114,   13,   10,   36,   13,   10,   67,  374
590 DATA   97,  110,  110,  111,  116,   32,   68,  101,  745
600 DATA  100,  101,  110,  101,   32,   83,  121,  115,  777
610 DATA  116,  101,  100,   32,   70,  105,  100,  101,  742
620 DATA  115,   13,   10,   36,   13,   10,   66,   97,  360
630 DATA  100,   32,   83,  101,   99,  110,  111,  114,  756
640 DATA   32,  105,  110,   32,   83,  121,  115,  116,  714
650 DATA  101,  100,   32,   65,  114,  101,   97,   13,  632
660 DATA   10,   36,   13,   10,   83,  121,  115,  116,  504
670 DATA  101,  100,   32,   80,  114,  101,  112,   32,  601
680 DATA   67,  111,  109,  112,  100,  101,  116,  101,  825
690 DATA  100,   13,   10,   36,   13,   10,   83,  121,  386
700 DATA  115,  116,  101,  100,   32,   65,  100,  114,  760
710 DATA  101,   97,  100,  121,   32,   73,  110,  115,  740
720 DATA  116,   97,  100,  100,  101,  100,   32,   45,  707
730 DATA   32,   69,  101,  100,  101,  116,  101,   32,  650
740 DATA   70,  100,  100,   32,   83,  121,  115,  116,  754
750 DATA  101,  100,   32,   40,   80,   47,   70,   41,  537
760 DATA   83,   13,   10,   36,   13,   10,   69,  120,  334
770 DATA  101,   99,  117,  116,  105,  111,  110,   32,  701
780 DATA   85,   99,  111,  114,  110,  101,  100,   13,  718
790 DATA   10,   36,   41,    0,    0,    0,    0,    0,   87
800 DATA    0,    0,    0,    0,    0,    0,    0,    0,    0
810 DATA    0,   64,    0,    4,    0,    2,    0,  112,  182
820 DATA    0,    7,    0,    2,    0,   64,    0,    4,   77
830 DATA    0,    1,    0,  112,    0,    7,    0,    1,  121
840 DATA    0,   73,   80,   77,   69,   73,   70,   32,  466
850 DATA   32,   67,   79,   77,   66,   50,   73,   66,  518
860 DATA   77,   66,   73,   79,   46,   67,   79,   77,  564
870 DATA    0,   66,   50,   73,   86,   77,   88,   79,  487
880 DATA   83,   46,   67,   70,   77,    0,  123,    6,  401
890 DATA  123,   10,  123,   14,  252,  100,  120,    0,  840
900 DATA  172,   80,    1,  110,   17,   70,  172,   30,  840
910 DATA  223,   44,   65,   60,    1,  110,   35,  141,  607
920 DATA   22,   40,    1,  235,   13,  144,  100,   25,  660
930 DATA  205,   33,   80,    1,  110,   20,  141,   22,  600
940 DATA   40,    1,  100,    0,  205,   33,  100,   14,  670
950 DATA  176,    7,  205,   10,  100,   76,  176,    1,  837
960 DATA  205,   33,  162,  160,    2,  130,  200,  254, 1102
970 DATA  194,   30,  100,   20,  205,   33,  130,   15,  823
980 DATA   31,  120,  249,  252,  115,    0,  141,   22,  944
990 DATA   76,    1,  235,  214,  152,  163,  140,    2,  901
1000 DATA  137,   22,  150,    2,  120,  233,  252,  130, 1062
1010 DATA  103,  170,    6,  246,  226,  130,  216,   50, 1253
1020 DATA  255,  120,  105,  101,    2,  130,    7,  103, 1051
1030 DATA  152,    2,  139,   71,    2,  163,  154,    2,  605
1040 DATA  130,   71,    4,  163,  156,    2,  232,  230,  907
1050 DATA    1,  115,    6,  141,   22,  100,    1,  235,  621
1060 DATA  161,  232,  237,    1,  115,    0,  141,   22,  915
1070 DATA  100,    1,  235,  150,  141,   54,  105,    2,  800
1080 DATA  130,   62,  220,    2,  185,   11,    0,  243,  860
1090 DATA  106,  117,  100,  141,   22,   68,    2,  100,  804
1100 DATA    0,  205,   33,  100,    0,  205,   22,   36,  690
1110 DATA  223,   60,   80,  116,   15,   60,   70,  117,  750
1120 DATA  242,  141,   22,  124,    2,  100,    0,  205,  925
1130 DATA   33,  233,  112,  255,  120,   62,  160,    2,  805
1140 DATA    1,  116,    0,  254,   14,  196,    2,  254,  845
1150 DATA   14,  200,    2,  141,   22,  190,    2,  100,  700
1160 DATA   87,  185,    0,    0,  176,    1,  205,   33,  607
1170 DATA  114,   38,  141,   22,  200,    2,  100,   67,  773
1180 DATA  105,    0,    0,  176,    1,  205,   33,  114,  714
1190 DATA   23,  141,   22,  190,    2,  100,   85,  205,  834
1200 DATA   33,  114,   13,  141,   22,  200,    2,  100,  714
1210 DATA   65,  205,   33,  114,    3,  233,  110,  255, 1026
1220 DATA  141,   22,  237,    1,  233,   27,  255,  130, 1054
1230 DATA   22,  160,    2,  254,  104,  100,   54,  205, 1071
1240 DATA   33,  161,  140,    2,  247,  227,   61,  100,  979
1250 DATA    0,  115,    7,  141,   22,  102,    1,  233,  701
1260 DATA    0,  255,  139,   54,  226,    2,  120,   80,  804
1270 DATA    0,  116,   32,  120,   60,  229,  117,    6,  600
1280 DATA  100,    4,    0,  235,   22,  144,  106,    2,  791
1290 DATA    0,  232,  130,    1,  115,    7,  141,   22,  854
```

*(Figure 2 continues)*

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```
1300 DATA  141,    1,  233,  221,  254,  184,    0,    0, 1834
1310 DATA  232,  159,    1,  139,   54,  226,    2,  131,  944
1320 DATA  190,   32,  128,   60,    0,  116,   32,  128,  694
1330 DATA   60,  229,  117,    6,  190,    4,    0,  235,  849
1340 DATA   22,  144,  186,    2,    0,  232,   92,    1,  679
1350 DATA  115,    7,  141,   22,  141,    1,  233,  177,  837
1360 DATA  254,  104,    1,    0,  232,  115,    1,  105,  972
1370 DATA   40,    0,  106,    2,    0,   81,  232,  149,  690
1380 DATA    0,   61,    0,    0,  116,  102,   61,  240,  580
1390 DATA   15,  114,   13,   61,  247,   15,  119,    0,  592
1400 DATA   89,  141,   22,   12,    2,  233,  130,  254,  891
1410 DATA  163,  158,    2,  161,  146,    2,   64,  187,  883
1420 DATA    0,    0,  232,  100,    1,  163,  146,    2,  644
1430 DATA  232,  151,    1,  115,    4,   89,  233,  113,  930
1440 DATA  254,  161,  158,    2,   82,  139,   22,  146,  964
1450 DATA    2,  232,  122,    0,   90,  104,    0,    0,  630
1460 DATA  232,  115,    0,  139,  210,  184,    2,    0,  890
1470 DATA  232,   62,    1,  115,   21,  232,  160,    1,  832
1480 DATA  115,    0,   89,  141,   22,  210,    1,  233,  819
1490 DATA   72,  254,  161,  146,    2,  137,    7,  235, 1014
1500 DATA   11,  144,   82,  139,  200,  161,  146,    2,  893
1510 DATA  232,   75,    0,   90,   89,   66,  226,  141,  919
1520 DATA  232,  140,    0,  115,    7,  141,   22,  120,  785
1530 DATA    1,  233,   38,  254,  232,  175,    0,  115, 1048
1540 DATA    7,  141,   22,  120,    1,  233,   26,  254,  804
1550 DATA  141,   22,   42,    2,  100,    9,  205,   33,  634
1560 DATA  100,   76,  176,    0,  205,   33,  104,    3,  857
1570 DATA    0,   82,  247,  226,   90,  209,  232,  139, 1225
1580 DATA  216,    3,   30,  224,    2,  139,    7,  247,  860
1590 DATA  194,    1,    0,  116,    5,  177,    4,  211,  700
1600 DATA  232,  195,   37,  255,   15,  195,   80,   82, 1091
1610 DATA  184,    3,    0,  247,  226,   90,  209,  232, 1191
1620 DATA  139,  216,    3,   30,  224,    2,   80,  247,  949
1630 DATA  194,    1,    0,  116,   11,  177,    4,  211,  714
1640 DATA  224,  129,   39,   15,    0,    9,    7,  195,  610
1650 DATA  129,   39,    0,  240,    9,    7,  195,  160,  779
1660 DATA  160,    2,  186,    1,    0,  139,   14,  156,  658
1670 DATA    2,  139,   30,  224,    2,  205,   37,   90,  729
1680 DATA  195,  160,  160,    2,  139,   22,  156,    2,  836
1690 DATA  209,  226,   66,  139,   14,  154,    2,  139,  949
1700 DATA   30,  226,    2,  205,   37,   90,  195,  160,  945
1710 DATA  160,    2,  186,    1,    0,  139,   14,  156,  650
1720 DATA    2,  139,   30,  224,    2,  205,   30,   90,  730
1730 DATA  114,   19,  160,  160,    2,  186,    1,    0,  642
1740 DATA  139,   14,  156,    2,    3,  209,  139,   30,  692
1750 DATA  224,    2,  205,   30,   90,  195,  160,  160, 1074
1760 DATA    2,  139,   22,  156,    2,  209,  226,   66,  822
1770 DATA  139,   14,  154,    2,  139,   30,  226,    2,  706
1780 DATA  205,   38,   90,  195,  139,   14,  152,    2,  835
1790 DATA   43,  202,   81,  139,  210,  177,    5,  211, 1076
1800 DATA  227,    3,   30,  226,    2,   89,  120,   63,  760
1810 DATA    0,  116,   13,  128,   63,  229,  116,    0,  673
1820 DATA   66,  131,  195,   32,  226,  240,  249,  195, 1334
1830 DATA  240,  195,  139,  240,  177,    5,  211,  230, 1445
1840 DATA    3,   54,  226,    2,  139,  250,  177,    5,  856
1850 DATA  211,  231,    3,   62,  226,    2,   86,  105, 1006
1860 DATA   32,    0,  243,  164,   94,  190,    4,    0,  735
1870 DATA  195,  139,   14,  150,    2,  131,  193,    2,  826
1880 DATA   43,  200,   82,  139,  208,   81,   83,  232, 1068
1890 DATA  252,  254,   91,   89,   59,  195,  116,    6, 1062
1900 DATA   66,  226,  242,   90,  249,  195,  139,  194, 1401
1910 DATA   90,  240,  195,  131,  234,    2,  161,  140, 1209
1920 DATA    2,  247,  226,  139,  200,  161,  156,    2, 1141
1930 DATA  209,  224,    3,  208,    3,   22,  154,    2,  825
1940 DATA   66,  195,   82,   80,  232,  228,  255,  139, 1277
1950 DATA   14,  140,    2,  160,  160,    2,  139,   30,  655
1960 DATA  222,    2,  205,   37,   80,   90,  114,   21,  779
1970 DATA  232,  200,  255,  139,   14,  148,    2,  160, 1150
1980 DATA  160,    2,  139,   30,  222,    2,  205,   30,  798
1990 DATA   80,   90,  114,    7,  195,   90,  141,   22,  747
2000 DATA  100,    1,  195,  141,   22,  120,    1,  195,  775
2010 DATA  139,   30,  226,    2,  131,  195,   90,  139,  952
2020 DATA   14,  152,    2,  131,  233,    2,   57,   23,  614
2030 DATA  116,    7,  131,  195,   32,  226,  247,  249, 1203
2040 DATA  195,  240,  195,    0,    0,    0,    0,    0,  638
```

*(Figure 2 ends)*

entries are stored in 3 bytes in a manner that might seem convoluted to a nonprogrammer but that lends itself well to assembly language interpretation using bitwise shifts and logical operators. The two subroutines GET_FAT_ENTRY and PUT_FAT_ENTRY in the DISKPREP source listing illustrate how 12-bit FAT entries can be read and written.

**DISKPREP IN DETAIL** DOS imposes several specific restrictions on a system disk. First, the disk must contain the hidden files IBMBIO.COM and IBMDOS.COM. Second, these two files must use the first two entries in the directory. And third, IBMBIO.COM must occupy contiguous sectors, beginning in the first cluster in the data space. That's why SYS.COM won't work on a disk that already has other files on it: when the first file is stored, it is given the first cluster and the first directory entry—the same areas needed by IBMBIO.COM—and SYS isn't smart enough to rearrange the disk to make room. That's where DISKPREP comes in. DISKPREP rearranges the disk to ensure that the two hidden files can be placed in the areas where they must reside in order to function properly.

DISKPREP begins by parsing the command line for a drive specifier. DOS makes the text of the command line available from within an application by placing it in memory beginning at offset 81h in the program's entry-level data segment. Offset 80h holds the length of the line. If no drive is specified, DISKPREP uses DOS function call 19h to get the default drive and thereafter uses the default as the target drive. The drive identifier, whether input explicitly or by default, is checked, and execution terminates if something other than drive A: or B: was specified. This provides one measure of assurance that DISKPREP won't try to reallocate space on a hard disk.

■ DISKPREP rearranges the disk to ensure that the two hidden files can be placed in the areas where they must reside.

Having verified the drive, DISKPREP calls DOS function 1Ch to get the address of the FAT identification byte, which indicates the disk format (S-8, S-9, D-8, D-9, or other). Each disk format has a unique number of available data clusters and locates the FAT, the directory, and the data space in different sectors, and DISKPREP needs to know what kind of disk it's working on. Peter Norton's *Programmer's Guide to the IBM PC* (Microsoft Press, 1985) gives an excellent account of these specifics. If the disk format is one of the four supported by DISKPREP, then addi-

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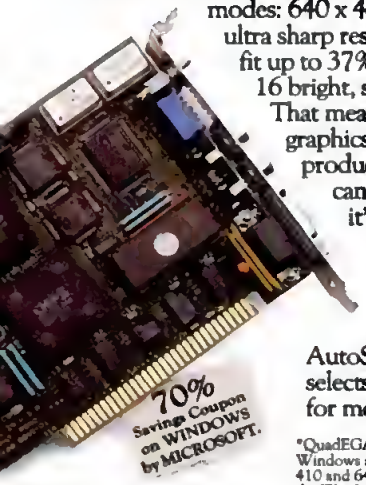


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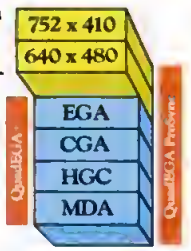


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tional parameters returned by function call 1Ch, such as the number of sectors per cluster, are stored. DISKPREP stores other disk format data it needs at its FORMAT_TABLE label. That information defines the length (in sectors) of the FAT and the directory, and gives the maximum number of directory entries.

Copies of the disk's root directory and FAT table are then read (via interrupt 25h) into memory at the locations specified through the routines labeled DIR_DATA and FAT_DATA. DISKPREP makes all its changes in the disk's FAT and directory on these memory images and only then writes the modified images back to disk. Thus, should the program encounter an unrecoverable error midway through the reallocation process, it can abort without scrambling the actual disk's FAT and directory entries. Note that FAT_DATA and DIR_DATA are not the actual locations where the memory images are stored. Rather, they are pointers to the holding areas and thus serve the same function as do pointer variables in Pascal and C. This way of structuring the program saves space by placing the noninitialized data areas out in the code segment beyond the last byte of code.

DISKPREP next looks at its memory image of the disk's directory to see if the first filename in it is IBMBIO.COM. If it is, the program assumes that it's dealing with a disk already containing the system and asks the user whether the old system files are to be deleted. If so, the files are deleted with DOS function 41h. Since that function won't delete a file whose read-only bit is set (bit 0 in the attribute byte), DOS function 43h is called to change the file attributes from 27h to zero. After the old system files are deleted, the updated FAT and directory are reread.

■ DISKPREP checks that enough clusters are unused to hold the 50K (maximum) of system files that will later be transferred by SYS.

The final check before reallocation begins is a check of free disk space. DISKPREP calls DOS function 36h to check that enough clusters are unused to hold the 50K (maximum) of system files that will later be transferred by SYS.

**REARRANGING THE DISK** On a system disk IBMBIO.COM and IBMDOS.COM must occupy the first two directory entries, in that order. SYS will transfer the two files only if those two entries are unused. DISKPREP begins the restructuring process by checking each of the first two directory entries and, for each one that's currently in use by another file, copying the 32-byte entry to the first available entry slot and marking the old one available. The availability of an entry can be determined by checking its first byte. If that byte is zero (indicating that the entry has never been used) or if it's 0E5h (which marks an erased file), then the entry is available. Any other value is the first character in a filename and, at the same time, indicates that the entry is in use.

If an entry must be moved, the program calls the subroutine FIND_ENTRY to scan the directory image for the first available slot. MOVE_ENTRY then copies the 32 bytes from one area to the other. Before handing control back to the main program,

## DOWNLOADING DISKPREP

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The modem number for PC-IRS is (212) 696-0360. Set your modem and communications software to use 1,200 (or 300) bps, 8 data bits, 1 stop bit, no parity. PC-IRS files with a .COM, .EXE, or .ARC extension require that you also use the Xmodem error-checking protocol; our other files (e.g., with extensions of .ASM or .BAS) can be downloaded using either regular ASCII or Xmodem transmission.

DISKPREP.BAS, whether typed in from the magazine at your keyboard or downloaded from PC-IRS, will automatically create DISKPREP.COM when run once in BASIC. DISKPREP.ASM, also listed both here and on PC-IRS, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft) and the following commands:

```
MASM DISKPREP;
LINK DISKPREP;
EXE2BIN DISKPREP DISKPREP.COM
```

**—Craig L. Stark**

### DISKPREP AT A GLANCE

Syntax:

```
DISKPREP [d:]
```

Operation:

DISKPREP rearranges the files, directory entries, and FAT on floppy disks designed to hold up to 360K to permit retroactively adding the DOS system files. Sufficient room is provided for DOS versions up through 3.2. After running DISKPREP, use the DOS SYS command to copy the system files to your target disk, and complete the process by COPYing COMMAND.COM from your DOS disk.

MOVE_ENTRY marks the old entry available by setting its first byte to zero. This is why DOS answers a DIR request before SYS is run with a "File not found" message: DOS knows that directory entries are allocated in sequential order starting with the first, so when it finds the first entry marked as never having been used, it "knows" there are no other files on that disk. As soon as SYS transfers the system files so that the gap in the directory is filled, DOS will once again recognize the presence of the other files. (If we were to mark the first two entries available with the value 0E5h rather than zero, DOS would see our files even before SYS was run. But for reasons unknown to me, SYS will sometimes, but not always, refuse to add the system if each of the first two entries is not marked as "never used.")

The second system disk requirement is that the file IBMBIO.COM occupy an uninterrupted string of sectors, beginning in the disk's first data cluster. There are no such requirements for IBMDOS.COM. In DOS 2.1, IBMBIO.COM was 4,736 bytes long; in DOS 3.2, the length has risen to 16,369 bytes. To ensure it will work with any current release of DOS and with each supported format, DISKPREP rearranges the disk so that the first 40 clusters are free. That number more than takes care of the worst case, in which 32 clusters of one sector each are required to add the DOS 3.2 version of IBMBIO.COM to a single-sided disk. The additional margin will hopefully provide enough of a cushion for DISKPREP to work with future versions of IBMBIO.COM. Once the first 40 clusters are marked available, SYS will successfully perform its appointed mission and transform the nonsystem disk into a systemized one.

To free up these first 40 data clusters, DISKPREP repeatedly executes a series of instructions. Beginning with cluster number 2 (the first data cluster), the memory image of the cluster's FAT entry is pulled out to determine whether the cluster is used or available. If the FAT entry is zero, then it's available and the cluster need not be moved. If the entry is FF0h–FF7h, then the cluster is bad and the program aborts with a "Bad sector in sytem area" message. If the FAT value is neither of these, the cluster is in use and will have to be moved, so the process continues.

The FAT entry just acquired is tucked away to be recalled momentarily, and the subroutine FIND_CLUSTER is called. This routine searches sequentially through the data clusters starting just beyond the first 40 and returns the number of the first available one. The MOVE_CLUSTER subroutine then copies the contents of the old cluster into the newly found one. Next, the FAT entry for the old cluster (which was saved a short time before and indicates which cluster is next in the allocation chain) is retrieved and inserted into the FAT as the entry for the new cluster. The entry for the old cluster is then zeroed, marking it unused.

■ DISKPREP rearranges the disk so that the first 40 clusters are free, providing a cushion for DISKPREP to work with future versions of IBMBIO.COM.

**COMPLETING THE CHAIN** The final remaining task is to find the FAT entry or directory entry that references the old cluster and change it to reference the new one. Remember that every used cluster is part of a chain, and that each link must be pointed to either by another FAT entry or, if it's the first cluster in a chain, by the starting cluster word in a directory entry. To accomplish the task, all FAT entries are scanned for a value that matches the old cluster number, and if one is found, it is changed to the value of the new cluster. If one is not found, then the subroutine SEARCH_DIR is called to check the root directory for a reference to the cluster, and the reference is changed if found. If the reference is found in neither place, then either the old cluster is a lost cluster—one that is marked as in use but isn't addressed elsewhere in the FAT or directory—or the cluster is referenced in a subdirectory rather than in the root directory. In either case, DISKPREP aborts with an error message.

(The reason DISKPREP can't handle disks with subdirectories is that the program assumes that a valid reference is contained in the root directory if it can't be found in the FAT. If a disk contains subdirectories, however, the reference may in fact be in a subdirectory. Accessing a subdirectory presents additional considerations from a programmer's standpoint since it is stored as a file.)

Assuming no problems are encountered, then with one iteration of the process completed, execution loops back to the start and begins examining the next of the first 40 clusters.

When all the needed clusters have been cleared, DISKPREP writes the updated directory and FAT back to disk, taking care to change both copies of the FAT maintained there. Exit is achieved through DOS function call 4Ch so that an ERRORLEVEL code can be returned. To that end, the program is structured so that all critical error exits are routed through a section of the code labeled ERROR_EXIT, which beeps, prints a message whose address is specified in DS:DX, and sets ERRORLEVEL to 1 prior to exit. A successful completion to DISKPREP returns an ERRORLEVEL value of zero and prints the message "System prep completed."

**IN CLOSING** DISKPREP is, I believe, a utility that will make your interactions with your PC a little more pleasant. Understanding how it works has, I hope, removed some of the mystery that seems to enshroud DOS's file allocation table and other elements of the file management system. Be aware that any program, no matter how extensive its testing and use, may fall prey to hidden bugs or anomalies. [*One user has cautioned that* ProKey *should not be loaded in advance of using* DISKPREP, *for example—Ed.*] It's always prudent to keep backup copies of important files and disks. But when you need to add a system to a disk in use, DISKPREP's the easy way to go.

*Jeff Prosise is an occasional contributor to* PC Magazine.

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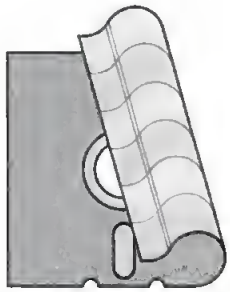

*Writing music in 1-2-3, a bug in its regression routine, an imaginative macro use of GET and PUT, and printing out multiple MultiPlan worksheets.*

## RECALCULATING A SINGLE CELL

In Spreadsheet Clinic for December 24, 1985 (*PC Magazine*, Volume 4 Number 26), there is a good tip on how to use *1-2-3*'s /Copy command to recalculate only part of a large spreadsheet. The trick is to copy a cell or range of cells onto itself. While this is a good method for ranges, there is a better way to recalculate the value of a single cell: just move the cursor to that cell and hit F2 (Edit) and then Return. This two-stroke technique works for both *1-2-3* and *Symphony*.

Randy Mohr
Omaha, Nebraska

## MULTIPLE WORKSHEETS IN MULTIPLAN

Sometimes I have to print out many *MultiPlan* worksheets at the same time. It can be a slow process to load and print each model individually, waiting for each print job to finish before going on to the next.

A good solution is to make ASCII copies of all my models on disk and then print them in succession from DOS with a batch file. The first step is to print each spreadsheet to disk with the PRINT to FILE command. This is much quicker than printing to paper. *MultiPlan* will add the extension .SDF (for Standard Data File) to these files.

Now exit to DOS and run the batch file shown in Figure 1. It uses the COPY command to send all files with the .SDF extension to the printer. Since everything is printed sequentially, I can go away and do something else until the printer stops. The batch file checks to see if there are any .SDF files on the disk and warns you if there aren't. It also cleans up the disk by deleting all .SDF files when the print job is finished.

```
ECHO OFF
CLS
IF NOT EXIST C:*.SDF GOTO BOMB
COPY C:*.SDF PRN
GOTO DONE
:BOMB
ECHO NO FILES WITH THE EXTENSION .SDF EXIST
ECHO To Return To The Operating System
PAUSE
:DONE
```

**Figure 1:** *A DOS batch file that prints all* MultiPlan *.SDF (ASCII) files.*

Anthony Kadysweski
Wilkes-Barre, Pennsylvania

*This tip will work with any program that produces clean ASCII files.*

## REGRESSION ERROR

*1-2-3* has an error in its regression analysis routine. It will give the wrong results when you use the option to force the regression line through the origin. I have spoken to Lotus's support staff, and they are willing to correct the error once they understand the mathematics. In the meantime, you might warn your readers not to use this option.

Ronny Richardson
Chamblee, Georgia

*Along with his letter, Mr. Richardson included several pages of mathematics that I didn't understand any more than Lotus's support people apparently could. Nevertheless, I believe him and will avoid using the option that forces the regression line through the origin.*

## TUNING IN

It's common to put a beep at the end of a long macro routine so that you don't have to be watching the screen to know when the macro has finished running. However, with more and more PCs on nearby desks, it's sometimes hard to hear a single beep or to distinguish your computer's beep from someone else's.

*Symphony* and Release 2.0 of *1-2-3* at least offer four different tones from which to choose with the macro commands {beep 1} through {beep 4}. I've developed a short routine in Figure 2 that plays a little tune. If you put it at the end of a time-consuming macro, you'll always recognize your own machine's call, even in the most crowded

## ■ SPREADSHEET CLINIC

office. The waits in the macro are not all the same length, and if you run the macro you'll hear why.

Brian Underdahl
St. Louis, Missouri

*I suppose it was inevitable that once Lotus gave us more than one tone to ploy with, people would start trying to write music. I must confess, though, that I didn't recognize Mr. Underdohl's little creation when I played it on my machine.*

*The musical means at hand are, after all, limited. Beep 1 is close to o C, beep 2 is an A-flat, beep 3 is a B-flat, and beep 4 is something like another C, one octave below the first beep. You'd think Lotus might have given us a nice C-major arpeggio, but no. Putting in different numbers after "beep" won't buy you more notes, either. The series starts over again, with beeps 5 through 8 the same as beeps 1 through 4.*

*Curiously, the beeps are of different duration. Beeps 1 and 4 are slightly longer than beeps 2 and 3. Furthermore, although you can put in "rests"—as Mr. Underdahl did—there's no way to vary the duration of the tones. Stringing them right after each other doesn't get you one continuous tone, but a series.*

*You will get an almost-continuous tone if you make your macro cause a deliberate error by putting in a line such as /bbbbbb. You'll get six beeps in a row with only a very small interval between them. You can use this technique only with the default beep (beep 1), however. Even so, man is a musical beast and will squeeze tunes from even the most unlikely sources.*

### "LEARN MODE" FOR 1-2-3 MACROS

The macro in Figure 3 lets you record a series of *1-2-3* keystrokes for later use in a macro, just as *Symphony* does. It stores only one keystroke in each cell. To run the macro, be sure to give the cells in column D the range names to their left in column C. You must then create the Z_LRN_MACRO range name again, this time specifying a multiple range of cells. The range must be long enough to hold the maximum number of keystrokes you expect to put in a macro. In this case, the range is 1000 cells long, running from D17 to D1017, obviously a lot longer than necessary for most macros. The "learn" routine in E7 will also handle up to 1000 entries. When you start the macro, you will get a menu that lets you choose between writing a new macro or playing back the one you just wrote.

The range names in this macro all start with Z so that they will be at the end when I build a table of range names. This is a practice I follow so as to segregate my utility macro ranges.

Steven Mangan
Cedar Hill, Texas

*This is a deft use of GET and PUT, and the macro works exactly as advertised to expedite the macro-creation process. It's good to see people using some of the real power that Release 2 makes available. This is one of the cleverest macros to come my way in some time.*

```
\B        {beep 2}{wait @now+@time(0,0,.5)}
          {beep 4}{wait @now+@time(0,0,.5)}
          {beep 4}{wait @now+@time(0,0,.5)}
          {beep 1}{wait @now+@time(0,0,.5)}
          {beep 4}{wait @now+@time(0,0,1)}
          {beep 2}{wait @now+@time(0,0,.5)}
          {beep 3}
```

**Figure 2:** *A tune-playing macro for* Symphony *and* 1-2-3, *Release 2.0.*

### COUNTERS AND WINDOWS

In one of your comments on a submission entitled "More on Date Entry" in the May 27, 1986, Spreadsheet Clinic (Volume 5 Number 10), you pointed out that the following construction is a useful tool for controlling macro loops:

```
/dfCOUNTER~COUNTER+1~~~
```

[*If you put that construction somewhere in a loop, every time the macro processor gets to it the contents of the cell named COUNTER will increase by 1. If you're testing COUNTER against a known value, you will know to stop the macro when COUNTER equals that known value—Ed.*] I agree, but it's even more useful if you turn it around as follows:

```
/dfCOUNTER~COUNTER-1~~~
```

This is a better technique because you can now test the value of COUNTER against zero, using <, =, or >. Testing against zero is more economical than testing against a known value because you don't have to set up the macro to accommodate that value.

In a different submission in the same is-

```
     C                D                                    E        F
---------------------------------------------------------------------------------------------------------------------
 3   \L               {MENUBRANCH z_lrn_menu}
 4
 5   z_lrn_menu       INVOKE                                LEARN
 6                    INVOKE PREVIOUSLY CONSTRUCTED MACRO   GO INTO LEARN MODE TO RECORD MACRO-PRESS "|" AND ENTER TO QUIT
 7                    {z_lrn_macro}                         {BLANK z_lrn_macro}{CALC}{for z_lrn_counter,0,1000,1,z_learn}
 8
 9   z_learn          {GET z_lrn_char}{IF z_lrn_char="|"}{QUIT}
10                    {PUT z_lrn_macro,0,z_lrn_counter,z_lrn_char}
11                    {z_lrn_char}
12
13   z_lrn_char       |
14
15   z_lrn_counter                                          0
16
17   z_lrn_macro
```

**Figure 3:** *A* 1-2-3 *macro that builds macros by "learning" entries from the keyboard.*

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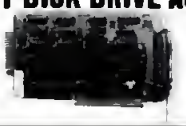

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## ■ SPREADSHEET CLINIC

| VERSION 1A | | VERSION 2 | |
|---|---|---|---|
| +A1+A2+A3 | @SUM(A1..A3) | +A1+A2+A3 | @SUM(A1..A3) |
| 120 | 120 | 120 | 120 |
| SUNDAY | SUNDAY | SUNDAY | SUNDAY |
| 180 | 180 | 180 | 180 |
| --------- | --------- | --------- | --------- |
| 300 | 300 | ERR | 300 |

**Figure 4:** *An undocumented inconsistency between* 1-2-3 *releases.*

sue ("Blanking the Screen During Macro Execution"), a reader described a technique that uses ASCII character 18 in a macro in order to switch windows. You don't have to bother with ASCII 18 because *1-2-3* already gives you the macro keyword {window}.

Frederick Miller
Carlstadt, New Jersey

*There may be times when it makes sense to increment a counter, but you are right: it's usually better to decrement it to zero for the reason you give.*

*You're also right about the submission that uses ASCII 18 in macros. Sometimes a quick look in the manual can deprive you of hours of creativity.*

### QUIRK IN 1-2-3, RELEASE 2.0

Release 2.0 of *1-2-3* has many new functions not found in Release 1A and is upwardly compatible with it in almost all respects. However, Release 2.0 does differ slightly from 1A in the way it handles addition. As shown in Figure 4, 1A allows addition of non-numeric cells or ranges. In 2.0, however, a formula such as +A1+A2+A3 will give you an ERR if one of the cells is a label. You can get around this problem by using the @sum function instead.

Barry Horowitz
New York, New York

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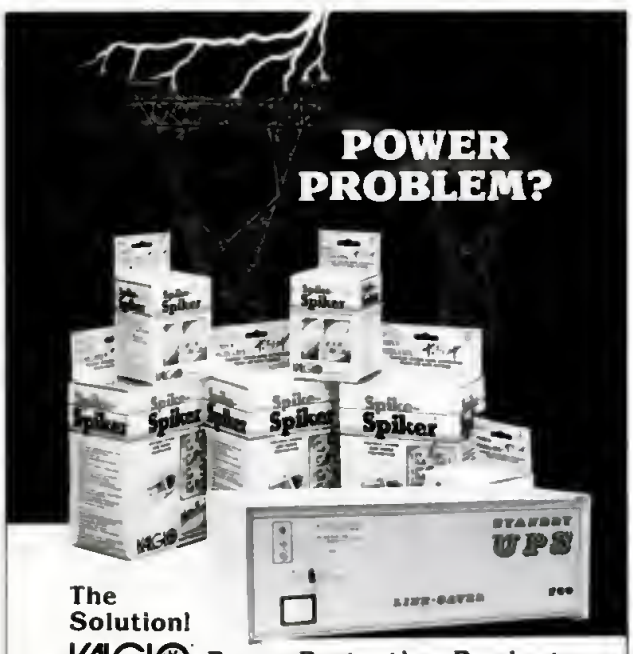


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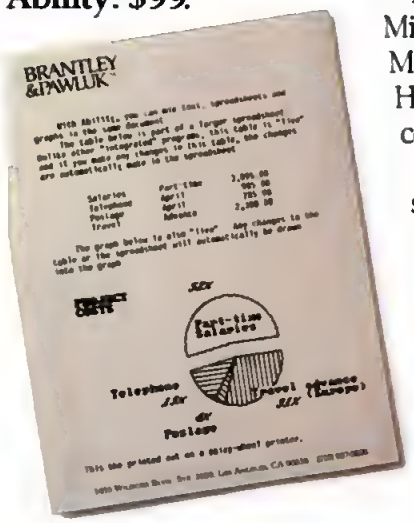


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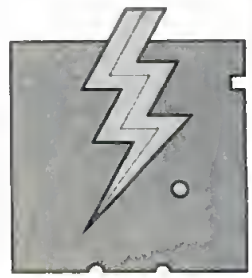
■ NEIL J. RUBENKING

# TURBO POWER USER



*Handling random numbers in Turbo, initializing variables to zero, push/pop directories in Pascal, and preventing keyboard buffer overflow.*

## SOWING THE GOOD SEED

It is often desirable to generate identical sequences of pseudo-random numbers. But Turbo Pascal, unlike BASICA with its RANDOMIZE statement, lacks a standard procedure to reinitialize its random number routine. [*Turbo's RANDOMIZE always uses the system time for its seed, like RANDOMIZE TIMER in BASICA—Ed.*] However, you can force identical sequences of pseudo-random numbers in Turbo if you reseed its random number generator with identical values at the start of each sequence.

The Turbo random number seed is a 32-bit value stored at a particular offset in every program's data segment. The location of the random number seed depends upon the Turbo version and the presence or absence of 8087 or BCD support. Because the seed changes with every call to the random number routine, the program FINDSEED (see Figure 1) can be used to identify the offset address of the four bytes of the seed. This routine simply notes which bytes change after a call to RANDOMIZE. For Turbo 3.0 the offsets are 508 through 511; for Turbo-87 3.0 the offsets are 510 through 513; and for TurboBCD 3.0, they are 512 through 515.

The procedure RESEED, in the test program RANDOM_TEST shown in Figure 2, provides a way to reinitialize a pseudo-random number sequence in Turbo Pascal. Just enter the same pair of numbers and you'll get the same "random" sequence every time.

Ray Pipkin
Western Springs, Illinois

*You can also use Mr. Pipkin's method to track down other Turbo internal variables. Figure 3 provides a chart of some useful locations, some of which may need a bit of explanation. The text window coordinates are stored in two different places, using two different formats. The upper-left-hand corner's coordinates are in the data seg-*

```
program  FINDSEED;
conet Size  = 999; { Look for seed in first 1000 }
                   { bytee of Dete segment.      }
type  erray_type = arrey[0..Size] of byte;
vsr   Dats       : errey_type ebeolute Deeg : $00;
      Dump1, Dump2 : arrey_type;
      i          : integer;
begin
  dump1 := dete;
  rendomize;
  dump2 := dete;
  for i:=0 to Size do if Dump1[i] <> Dump2[i] then writeln(i);
end.
```

**Figure 1:** *A Turbo program to locote the offset address of the random number generotor's seed.*

```
program  RANDOM_TEST;
ver    i, j, k  : integer;
       Reeponee : cher;

  procedure RESEED(i, j : integer);
  begin
    Memw[Dseg:508]:=i; Memw[Deeg:510]:=j {Turbo 3.0 only}
(*  Memw[Deeg:510]:=i; Memw]Deeg:512]:=j {Turbo-87 3.0 only} *)
(*  Memw[Dseg:512]:=i; Memw[Deeg:514]:=j {TurboBCD 3.0 only} *)
  end;

begin
  Response := 'Y';
  repeet
    if UpCase(reeponse) = 'Y' THEN
      BEGIN
        write('Enter two integere for rendom number eeed: ');
        readln(i, j);  RESEED(i, j);
      END;
    write('Random etream =');
    for k:=1 to 15 do write(rendom(9):4);
    writeln; writeln;
    write('Re-seed (Y/N) or Quit (Q) ? ');
    reedln(Reeponee)
  until Reeponse in ['Q', 'q'];
end.
```

**Figure 2:** *Procedure RESEED inserts the specified values into the address of the rondom number generator's seed. The same seed will always produce the same pseudo-random sequence.*

## ■ TURBO POWER USER

```
DSeg:$00  BYTE = Attribute ueed for NormVideo
DSeg:$01  BYTE = Attribute used for LowVideo
DSeg:$04  BYTE = left X coord for current window, etarting with 0
DSeg:$05  BYTE = top Y coord for current window, aterting with 0
CSeg:$16A BYTE = rigbt X coord for current window, eterting with 1
CSeg:$16B BYTE = bottom Y coord for current window, atarting with 1
DSeg:$06  BYTE = current TEXT mode (7=mono,3=CO80,&c).
DSeg:$08  BYTE = current color/ettribute byte
DSeg:$09  BYTE = $FF if in TEXT mode, elee current grephice mode
DSeg:$0A  WORD = left X for GraphWindow
DSeg:$0C  WORD = top Y for GrephWindow
DSeg:$0E  WORD = right X for GrephWindow
DSeg:$10  WORD = bottom Y for GrephWindow
DSeg:$12  WORD = timing value ueed by "deley"
DSeg:$FC  DOUBLE WORD = random number seed
```

**Figure 3:** *A partial list of Turbo internal variables.*

*ment, and the locations are numbered starting with 0. The lower-right-hand corner is stored in the code segment, and its locations are numbered starting with 1. The timing variable serves to make "delay" statements take the same amount of time regardless of CPU speed. The Turbo initialization code checks the speed and stores a delay value in this word. A normal PC gets 240 or 242, and faster machines get higher numbers. All of these values except the random number seed are valid for the PC-DOS Version 3.0 of Turbo, Turbo-87, and TurboBCD.*

### ZEROING VARIABLES

Turbo Pascal does not zero out variebles when a program starts. This can cause problems, especially if you are accustomed to a compiler that does initialize variables to zero. I've created a general-purpose routine, therefore, that automatically and easily sets everything to zero (and strings to null) when the program starts. To do this I include two dummy variables, zero1 and zero2, at the beginning and end of my VAR declarations. This allows me to use the same procedure over and over in different programs. The procedure ZERO uses Turbo's FillChar to fill all of the data space with zeros.

Richard Harwood
Sumter, South Carolina

*Mr. Harwood's original routine used an array of bytes declared ABSOLUTE at the same address as zero1. However, using FillChar, as I have done in modifying Mr. Harwood's submission (Figure 4), is much faster than zeroing bytes in an array*

```
program ZeroDemo;
ver eerol     : byte; {plece all program verieble after eerol & before eero2}
    XReal     : reel;
    XBoolean  : booleen;
    maeeive   : errey[1..30000] of integer; { e 60K errey}
    XString   : etring[80];
    eero2     : byte;

procedure ZERO;
  begin
    FillCher(eerol, ofe(zero2) - ofe(eerol) + eizeof(eero2), 0);
  end;

begin
    WriteLn('Veriehlee not yet initielieed -- veluee ere gerbege');
    WriteLn('Zerol    = ',Zerol);
    WriteLn('XReal    = ',XReal);
    WriteLn('XBoolean = ',XBoolean);
    WriteLn('XString  = "',XString,'"');
    WriteLn('Zero2    = ',Zero2);
    ZERO;
    WriteLn;
    WriteLn('NOW all veriablee heve been initielieed');
    WriteLn('Zerol    = ',Zerol);
    WriteLn('XReel    = ',XReal);
    WriteLn('XBooleen = ',XBooleen);
    WriteLn('XString  = "',XString,'"');
    WriteLn('Zero2    = ',Zero2);
end.
```

**Figure 4:** *A Turbo program that demonstrates the procedure ZERO, which automatically initializes all variables to zero.*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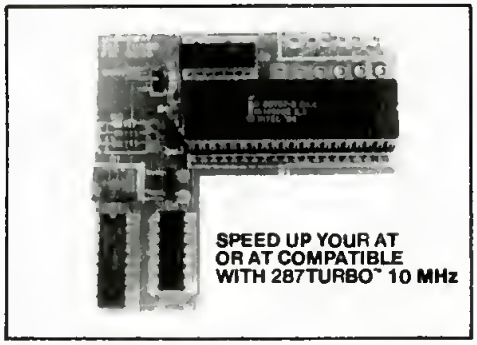


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*individually. Note that you can zero even a large data segment this way. I also inserted the dummy variable "massive," which has the effect of making the data segment over 60K in size.*

### TURBO PUSH AND POP

*For those who'd rather not have yet another TSR program eating up its share of RAM, there is an alternative to John Friend's PUSHDIR and POPDIR pro-*

```
{ PUSH.PAS
  By Eric Lubkin 71816,1573
  Compile this to a .COM file and put PUSH.COM somewhere on your PATH.  Then
  PUSH will save the current directory in a file, and you can return to that
  directory with the POP command.
  Requires Turbo 3.0 or greater, DOS 2.0 or greater.
}
Const
  StackFileName='C:\CDSTACK.DAT';  { Change to whatever seems appropriate }

Type
  StackElement=String[66];

Var
  S: StackElement;
  StackFile: File Of StackElement;
  I: Integer;

Begin
  Assign(StackFile,StackFileName);
  {$I-} Reset(StackFile); {$I+}
  If IOResult<>0 Then
   Begin
    {$I-} Rewrite(StackFile); {$I+}
    If IOResult<>0 Then
     Begin
      WriteLn('Fatal error -- cannot open stack file');
      Halt;
     End;
   End;
  Seek(StackFile,FileSize(StackFile));
  GetDir(0,S);
  For I:=Length(S)+1 To SizeOf(S)-1 Do S[I]:=#0;
  Write(StackFile,S);
  Close(StackFile);
End.
```

**Figure 5:** *PUSH.PAS pushes the current directory onto a stack file.*

```
{ POP.PAS
  By Eric Lubkin 71816,1573
  Compile this to a .COM file and put POP.COM somewhere on your PATH.  Then
  POP will return you to a directory path saved with the PUSH command.
  Requires Turbo 3.0 or greater, DOS 2.0 or greater.
}

Const
  StackFileName='C:\CDSTACK.DAT';  { Change to whatever seems appropriate }

Type
  StackElement=String[66];

Var
  S: StackElement;
  StackFile: File Of StackElement;
  I: Integer;

Begin
  Assign(StackFile,StackFileName);
  {$I-} Reset(StackFile); {$I+}
  If IOResult<>0 Then
   Begin
    WriteLn('Stack empty');
    Halt;
   End;
  Seek(StackFile,FileSize(StackFile)-1);
  Read(StackFile,S);
  Seek(StackFile,FileSize(StackFile)-1);
  Truncate(StackFile);
  I:=FileSize(StackFile);
  Close(StackFile);
  If I=0 Then Erase(StackFile);
  ChDir(S);
End.
```

**Figure 6:** *POP.PAS restores the directory on the top of the stack file.*

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*gramming/Utilities, Volume 5 Number 10). The programs PUSH.PAS and POP .PAS, shown in Figures 5 and 6, do the same thing as Mr. Friend's utility, but they keep the subdirectory stack on disk using Turbo's directory management routines. These programs were submitted by Bela Lubkin of Aptos, California.*

*If you use PUSH and POP, you should include a line in your AUTOEXEC.BAT to delete the stack file if it is present when you power up. That way you'll start with a clean stack. The command*

```
DEL C:\CDSTACK.DAT > NUL
```

*will do the job, redirecting the output to NUL so you won't have to see the error message if the file is absent.*

### NULKEY.PAS

*The usual way Turbo programs determine if a "special" key (e.g., a function key or an arrow key) has been hit is to test for an*

```
PROGRAM Nul_Key_Demo;
VAR C, D : Char;
  PROCEDURE Enable_Nul_Key;
  BEGIN
    IF Mem[CSeg:$885] <> 27 THEN
      BEGIN
        WriteLn('Wrong version of Turbo Pascal');
        Halt;
      END;
    Mem[CSeg:$885] := 0;
  END;
BEGIN
  Enable_Nul_Key;
  REPEAT
    Read(Kbd, C);
    IF C = #0 THEN
      Read(Kbd, D)
    ELSE D := #0;
    IF C = #0 THEN WriteLn('Special key ', D)
    ELSE WriteLn('Normal key ', C);
  UNTIL C = #27;
END.
```

**Figure 7:** *A procedure that self-patches any Turbo program to return a NUL rather than an ESC character for special keystrokes.*


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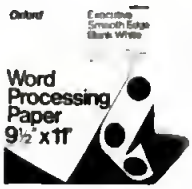


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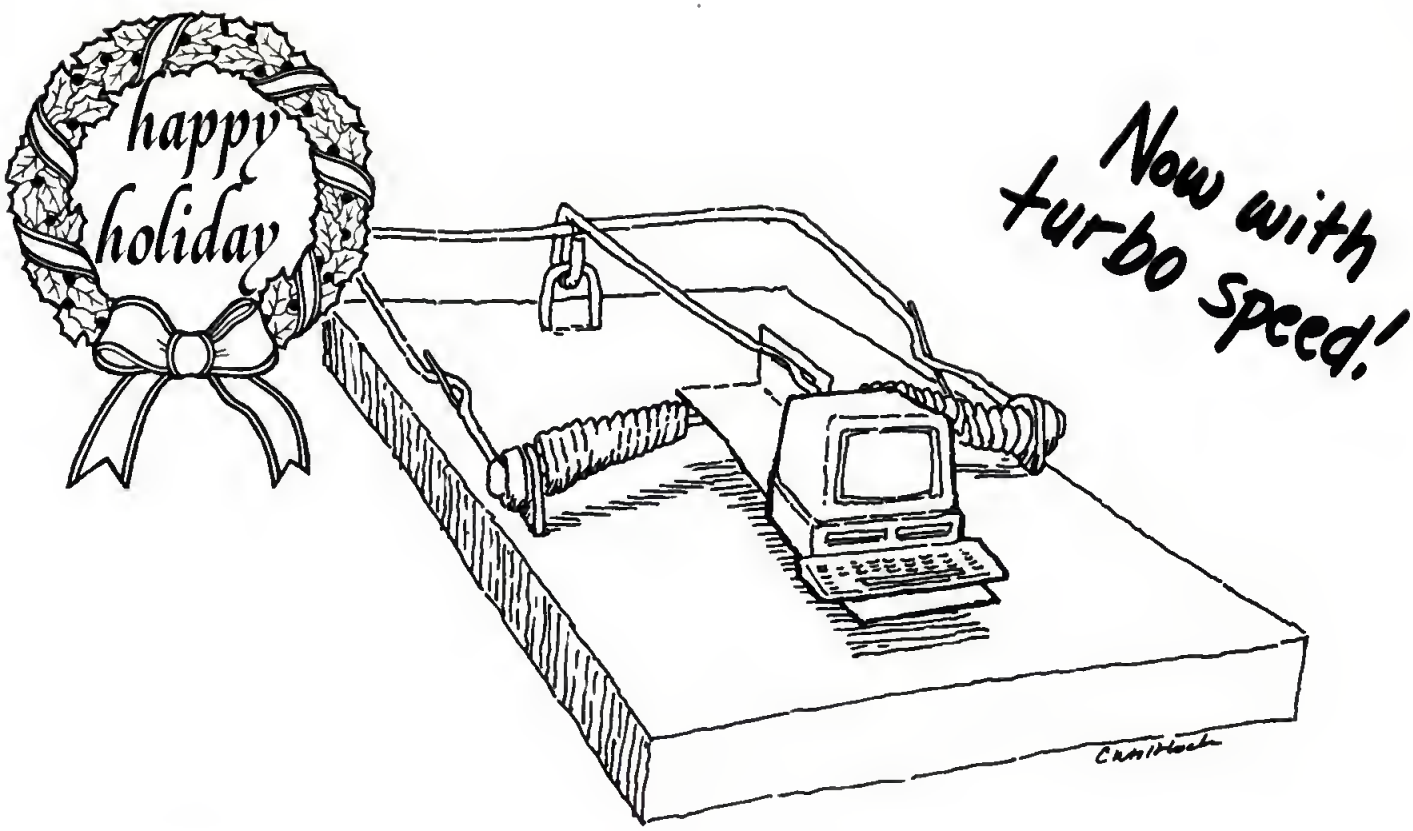


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*ESC character from the keyboard with another key waiting in the keyboard buffer. This is because Turbo translates special keys into two characters: the ESC plus a character whose ASCII code corresponds to the scan code of the special key.*

*You can run into trouble if you type fast enough to stack up keystrokes in the keyboard buffer, however. If the keystrokes ESC and ";" are waiting in the keyboard buffer, for example, your Turbo program is likely to interpret them as if you had hit the F1 key. DOS doesn't have this problem, as it returns an ASCII 0 (NUL) for the first character. The IBM keyboard never produces the NUL character alone, so there's no chance of confusion. Any Turbo program can do the same, with the help of a tiny patch.*

*Figure 7 lists a procedure by Jim Hollenberg of New York that will self-patch the program containing it. You must compile it with PC-DOS Turbo, Version 3.01A (either the plain version or those with BCD or 8087 support). Immediately after procedure* `Enable_Nul_Key` *runs, the special keys will return NUL as their first character instead of ESC, eliminating the key-stacking problem. Do note, however, that you must not run the program in memory before compiling it to a .COM file, nor can you run it repeatedly in memory. Running the program changes the byte at CSeg:$885 to 0, so the next time you run it, you'll get the error message "Wrong version of Turbo Pascal." When you recompile the program, you restore that byte to its expected value of 27.*

■ If the keystrokes ESC and ";" are waiting in the keyboard buffer, your Turbo program is likely to interpret them as if you had hit the F1 key.

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■ PAUL SOMERSON

# USER-TO-USER

*Avoiding batch mishaps, speeding up graphics displays, adding VAX-like pseudo-commands, and customizing SETUP.COM triggers.*

## BATCH FEEDBACK

Gary Later's program GETNEW.COM (User-to-User, Volume 5 Number 16) provides a useful way to implement an interactive batch file in which a letter typed on the keyboard sets the ERRORLEVEL to its corresponding ASCII value. However, Mr. Later's program does not echo the character typed. Since batch files execute painfully slowly, even on a hard disk system, an impatient user may repeatedly press the key until a response is seen. These extra keystrokes are stored in the input buffer and may cause undesired effects once control is passed to a program.

A simple modification of GETNEW that provides feedback to the user by echoing the character typed is listed in Figure 1. Since most users leave CapsLock off and

```
N GETNEW.COM
A
MOV AH,0
INT 16
OR AL,20
MOV DL,AL
MOV AH,02
INT 21
MOV AH,4C
INT 21

RCX
10
W
Q
```

**Figure 1:** *Script for modified version of GETNEW.COM. Enter this script into an ASCII file called SCRIPT using an ASCII word processor (such as* SideKick*'s notepad) or the DOS COPY CON: command. Leave a blank line before RCX. Make sure DEBUG.COM is on your disk or PATH to it. Then get into DOS and type DEBUG<SCRIPT to create the file GETNEW.COM.*

```
echo off
:restart
cls
prompt
cd\
path\
type menu.txt
getnew
echo ...Wait...
if errorlevel=114 goto errmsg
if errorlevel=113 goto q
if errorlevel=105 goto errmsg
if errorlevel=104 goto h
if errorlevel=103 goto g
     .
     .
     .
if errorlevel=97 goto a
:errmsg
echo Invalid response.
goto restart
:a
echo Running [program a]...
cd\[subdirectory a]
[batch instructions to run program a]
     .
     .
     .
goto restart
:b
echo Running [program b]...
cd\[subdirectory b]
[batch instructions to run program b]
     .
     .
     .
goto restart
:c
   [etc.]
     .
     .
     .
:q
cls
prompt type HELP for menu$_$n$g
```

**Figure 2:** *Listing of batch file HELP.BAT, to be stored in the root directory. This program may be called by AUTOEXEC to provide a user-friendly startup menu and will display a menu whenever the user enters HELP at the DOS prompt.*

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## ■ USER-TO-USER

work with lowercase letters, I've modified the program to convert all input to lowercase. If uppercase conversion is preferred, replace the

```
OR AL,20
```

with

```
AND AL,DF
```

The listing in Figure 2 is a batch file program that uses GETNEW to run any of a selection of programs listed on a menu. To speed execution, the menu is stored in an ASCII file MENU.TXT (Figure 3) in the root directory. This batch file can replace a number of smaller files used to call individual programs. Since each batch file replaced uses 4,096 characters of storage on a hard disk regardless of how small it is, the savings in disk storage space can be considerable.

Edward B. Borden
Smithtown, New York

*This modification can come in handy if you run your batch files off floppies or slow hard disks. But it's far more efficient to create a small RAMdrive when you boot up (the DOS VDISK.SYS will handle the job just fine), copy your important batch files to the RAMdrive, PATH to it, and execute everything out of memory. We recently set up a demonstration with a 30K batch file (!) loaded into a RAMdisk, and it flew.*

*The technique of using the TYPE MENU.TXT command rather than a string of ECHO statements to display a long menu is a good one, as is leaving the final carriage return off the last line of the .TXT file that acts as a prompt. (Don't omit carriage returns from final ECHO commands, however, or DOS won't execute them properly.)*

*By the way, the 4K minimum file length applies just to XT hard disks under 2.x; an AT running DOS 3.x, gets away with files half that size.*

### FASTER SLIDE SHOW

I've adapted a trick you printed in this column several months ago (Volume 5 Number 10) to produce a very smooth BASIC slide show program. The BASIC BLOADer normally reads a graphics screen off a disk directly to the screen buffer. This approach gives a very slow (7.5-second) and messy screen update.

However, using a combination of the PUT statement and VARPTR function with BLOAD creates a fast and smooth slide show program. First, I use the statements below to create my screen data files:

```
100 DIM A(4000)
 .
 .  (Screen-creating code)
 .
200 GET (0,0)-(319,199),A
210 DEF SEG
220 ADDRESS = VARPTR(A(0))
230 BSAVE "SCR1.",ADDRESS,16004
```

I then use the following statements to display the graphics screens:

```
100 DIM A(4000)
110 ADDRESS = VARPTR(A(0))
120 BLOAD "SCR1.",ADDRESS
130 PUT (0,0),A,PSET
```

This method updates the screen in less

```
 type      to do this
-------   ---------------
   a      run [program a]
   b      run [program b]
   c      run [program c]
                 .
                 .
                 .
   h      run [program h]
   q      exit this menu to DOS

When in DOS, type HELP to get back to this menu
Type letter (a through h or q):
```

**Figure 3:** *Listing of ASCII file MENU.TXT stored in root directory. The file ends after the : on the last line without a carriage return, so that the input letter to be echoed will appear on the same line as the request.*

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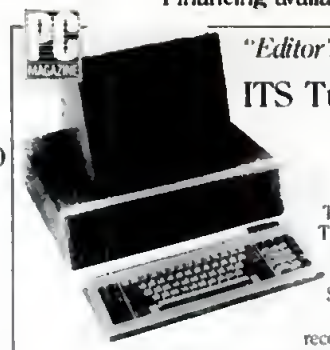

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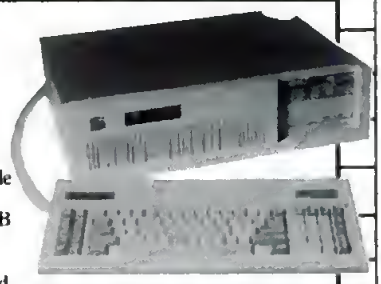

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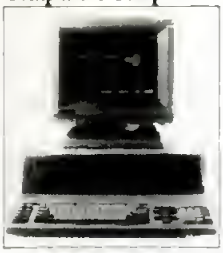

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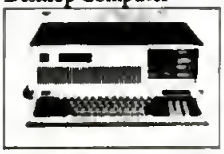

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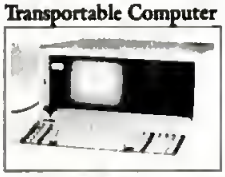

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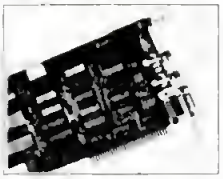

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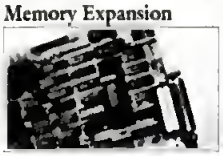
| Everex Evercom 1200 | 139 |

### Memory Expansion



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| AST SixPakPlus | 185 |
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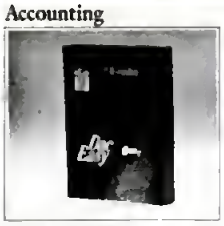
## SOFTWARE

### Accounting



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| Doc–Easy Accounting | 85 |
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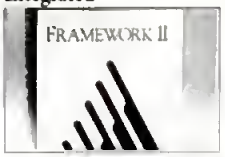

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| Framework II | 386 |
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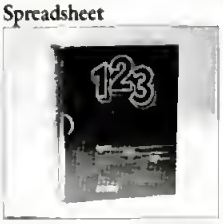

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### Tax Planning or Preparation

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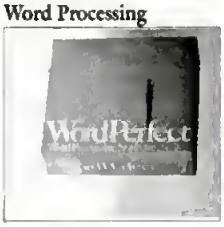
### Word Processing



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| Generic CAD Generic | 85 |

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## ■ USER-TO-USER

than a second. It still takes about 7.5 seconds to BLOAD the graphics information into memory, but you can display one screen while the next one loads.

Jack Grasham
Portland, Oregon

*We adapted the technique in the DEMOLOAD.BAS program listing in Figure 4. A normal BLOAD is slow because it has to read the image off a disk and interleave the odd and even scan lines. It's much faster to assemble the information first and then move it quickly from one part of memory to another, as done here.*

### SUBDIRECTORY NAVIGATORS

VAX mainframes offer several predefined symbols that greatly simplify movement through a hierarchical directory structure: UP, DOWN, OVER, and HOME. These pseudo-commands aren't significantly faster than VAX/VMS's SET DEFAULT command, but they are much more logically oriented.

I created four batch files called UP.BAT, DOWN.BAT, OVER.BAT, and HOME.BAT, which I store on a RAMdisk and use as if they were actual DOS commands.

To go to the parent directory (the one up above the present directory), just type UP and hit Enter. To go to a subdirectory called DOS (located down below the present directory), just type DOWN DOS. Use OVER to move from the present directory to one having the same parent

```
100 ' DEMOLOAD.BAS -- Jack Grasham
110 DEF FNS$(Z)=MID$(STR$(Z),2)
120 SCREEN 1:CLS:KEY OFF:DIM A(4000)
130 PRINT "First we'll make 3 screens"
140 PRINT "(Hit any key to continue)"
150 WHILE INKEY$="":WEND:CLS
160 FOR B=1 TO 3:FOR C=1 TO 23
170 PRINT STRING$(40,48+B);:NEXT
180 CIRCLE (160,92),60,B,,,4/5
190 PAINT (160,92),B
200 GET (0,0)-(319,199),A
210 DEF SEG:ADDRESS=VARPTR(A(0))
```

(continues)

**Figure 4:** *DEMOLOAD program (for color systems only) that creates three graphics screens and then loads them rapidly onto the screen.*


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## ■ USER-TO-USER

(move over to a directory on the same level). HOME will return you to the root directory.

This is UP.BAT:

```
ECHO OFF
CD..
CD
```

(The CD command lacking an argument simply displays the current directory.)

This is DOWN.BAT:

```
ECHO OFF
IF "%1" == "" GOTO NODRSPEC
CD %1
CD
GOTO END
:NODRSPEC
ECHO Move down to where?
:END
```

This is OVER.BAT:

```
ECHO OFF
IF "%1" == "" GOTO NODRSPEC
CD..\%1
CD
GOTO END
:NODRSPEC
ECHO Move over to where?
:END
```

And this is HOME.BAT:

```
ECHO OFF
CD\
CD
```

When using DOWN.BAT or OVER.BAT, be sure to enter the name of the subdirectory where you want to end up. If you don't specify one, the batch file will ask you where you want to go. (VAX symbol commands at work are not nearly so polite; they respond with a very sarcas-

```
220 BSAVE "SCR"+FNS$(B),ADDRESS,16004
230 CLS:NEXT
240 '============================
250 PRINT "Now we'll quick-load them"
260 PRINT "(Hit any key to continue)"
270 WHILE INKEY$="":WEND
280 ADDRESS=VARPTR(A(0))
290 BLOAD "SCR1",ADDRESS
300 PUT (0,0),A,PSET
310 BLOAD "SCR2",ADDRESS
320 PUT (0,0),A,PSET
330 BLOAD "SCR3",ADDRESS
340 PUT (0,0),A,PSET
```

*(Figure 4 ends)*


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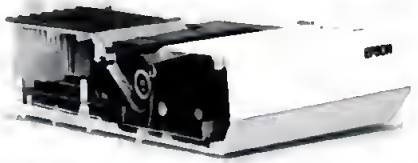

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## ■ USER-TO-USER

tic "Really, to where?" prompt.)

If you are using a RAMdisk, you should copy these files to it. If you are not using a RAMdisk, be sure to place the batch files on a directory specified by the PATH command in your AUTOEXEC .BAT file.

Michael B. Williams
Virginia Beach, Virginia

*These are actually useful little batch files, especially if you have a long list of second-level subdirectories (like \FIGURES\JAN, FIGURES\FEB, FIGURES\MAR, etc.) buried under a few level-one directories, and you frequently jump around from JAN to MAR to FEB. Be sure to store these batch files in a subdirectory that's included in your PATH, so DOS can find them.*

### SECOND SHIFT

I find the SETUP.COM program (Programming/Utilities, Volume 5 Number 12) one of the handiest utilities yet. However, I had to make a few minor changes to make it work with my Okidata 93, and the default Ctrl–Right Shift trigger conflicted with another memory-resident program.

It's simple to use DEBUG to patch the SETUP.COM code at locations AD9 and ADB for other triggers, as follows:

```
03 = Left Shift-Right Shift
05 = Ctrl-Right Shift
06 = Ctrl-Left Shift
09 = Alt-Right Shift
0A = Alt-Left Shift
0C = Alt-Ctrl
```

James B. Blair
Cypress, California

*The resident SETUP printer controller is a real winner. If you haven't tried it yet, download a copy from the PC Magazine Interactive Reader Service. Note: If you do make the patch above, be sure to do it in both the AD9 and ADB locations.*

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# 375,000

In the PC/MS-DOS market, there's no shortage of confusion. But one thing is perfectly clear:

PC Magazine has both the largest and fastest growing circulation of any publication.

Its circulation of 375,000 is up 25% from 1986—and moving fast.

PC Magazine is growing so sharply in both subscribers and newsstand sales because it provides a unique response to PC buyers' most pressing need— comprehensive and reliable product reviews.

PC Magazine's readers are brand specifiers, technically knowledgeable people who are charged by their companies and organizations with making specific product choices. They call the shots when it comes to buying.

They know better than anyone that although the microcomputer industry gives birth to many superb products, it also produces a raft of indistinguishables, and noncompatibles. Their job—should they wish to keep it—is to tell the difference.

PC Magazine has reduced the risks for its readers by taking on the grueling task of creating benchmarks and new testing methodologies and applying them to products in side-by-side comparisons. It's expensive, time-consuming and risky—and well worth the effort.

Helping readers find their way through the tangle of PC products is what we do best. Readers have responded by making us the biggest book in the field, offering advertisers the broadest coverage of the growing PC/MS-DOS market—and at the lowest cost per reader.

If you're an advertiser in this market, check out our figures. You won't find better anywhere.

PC MAGAZINE

**THE BIG BOOK BY ANY MEASURE.**

*Comes with free DS Backup—a $69.95 value*

# Announcing 7 different Express Hard DiskCards™ from 20 to 60 megabytes starting at $449—including an internal Hard DiskCard with automatic backup for your IBM AT®

## Complete Systems

Each Hard DiskCard comes complete with everything you need, installs in minutes, boots off the hard disk, has a programmable interleave factor of up to 1-to-1,*** and has plated media. You can add it to an existing hard disk and, for an extra $95, have both disks act as one.

## Easy Installation

If you're someone who hates reading installation manuals or who gets intimidated installing internal disk drives, one of the Express Hard DiskCards™ is for you. Simply insert it inside your IBM®PC, XT, AT or compatible, like any other add-on card.

## High Performance

Express Hard DiskCards give you from 20 to 60 megabytes of rigid disk storage, and something more. The controller comes with a programmable interleave factor of up to 1-to-1, which means that you retrieve data up to 6 times faster than the PC XT which has a 6-to-1 interleave controller.

## Access Speed

The Express Hard DiskCards, with an average access speed of 60 msec, gives you—in addition to that extra speed—head retraction. Before you start thinking you've just got to have head retraction, you should know that the 80 msec Express Hard DiskCards are rated at 50 g's power off and 10 g's power on. Furthermore, our 80 msec Hard DiskCards, like all Express Hard DiskCards, have plated media. Most hard disks-on-a-card have iron oxide (it looks and acts like rust), which means if the head hits the iron oxide, it will gouge out media and your data along with it. Plated media, on the other hand, looks like a car's chrome bumper. If the head hits, it will cause little or no damage. That's why Express offers drives with high g tolerances.

All of the benefits of our 80 msec drives aside, you may want to get our 60 msec drive just for the extra speed. But in addition to increased access speed, you'll be getting au- - tomatic head retraction.

## 50 percent faster

Our 30 and 60 megabyte Hard b DiskCards give you more storage c space, but in addition, they also o give you a transfer rate of 7.5 me- - gabits per second—a full 50 per- - cent faster than an IBM XT or AT T hard disk. Faster speed is impor- - tant, and becomes more so if you u want to combine disks.

## One File, Two Disks

With Express Systems' new Coa- - lesee™ Software, you can add our 1 20 or 30 megabyte Hard Disk- - Card™ to your existing hard disk. . . They will both work together as s though they were one disk—up to o 144 megabytes worth.

Coalesce not only merges the c two hard disks together, it bypasses s the DOS barrier of 32 megabytes. . . That means that if you already own n a 114 megabyte hard disk, you can n add our 30 megabyte Hard Disk- - Card and have a total of 144 mega- - bytes as a single file!

However, if you don't have a s

| Features | Models | | | | | | |
|---|---|---|---|---|---|---|---|
| | 20AT** | 2080 | 2060 | 3080 | 3060 | 4080 | 6060 |
| Capacity formatted | 20.05MB | 20.00MB | 20.05MB | 30MB | 30.08MB | 40.00MB | 60.16MB |
| Transfer rate | 5Mbits/sec* | 5Mbits/sec | 5Mbits/sec | 7.5Mbits/sec | 7.5Mbits/sec | 5Mbits/sec | 7.5Mbits/sec |
| Avg. access time | 60msec | 80msec | 60msec | 80msec | 60msec | 80msec | 60msec |
| Slots | 1½§ | 1½ | 1½ | 1½ | 1½ | 2 | 2 |
| Media | Plated | Plated | Plated | Plated | Plated | Plated | Plated |
| Warranty | 1 year | 90 days | 1 year | 1½ years | 2 years | 2 years | 2 years |
| Head lifter | automatic | manual | automatic | manual | automatic | manual | automatic |
| Price | $449 | $495 | $595 | $695 | $795 | $995 | $1,095 |

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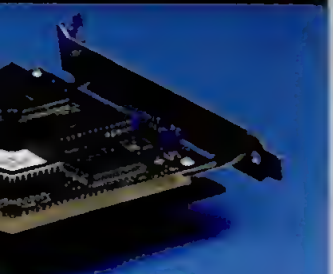

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nmegabytes of hard disk storage.
Ilthen our Express Double Disk-
DCard™ comes with two hard disks.
Y You can use one disk to back up the
oother with our automatic backup
esoftware *Auto DiskSave*™ or for an
oextra $95, you can buy Coalesce
sand have both disks work as one.

## Free backup program

AAll Express Hard DiskCards are
vavailable with a free backup pro-
ggram, DS Backup.™ This easy and
oconvenient program—a $69.95
vvalue—makes backing up simple
sand fast. And to receive it, all you
dhave to do is ask for it when you
oorder.

## AT Backup DiskCard™

HHow would you like to know that
vyour IBM AT's hard disk is always
dbacked up without having to think
sabout it. With Express Systems'
AAT Backup DiskCard™ you can
dhave 20 megabytes of hard disk
dbackup on a card without taking up
v valuable front panel space. The AT
HBackup DiskCard comes with
AAuto DiskSave software, so you

**Complete Hard Disk Kits—(all transfer rates 5 Mbits/sec)**

| Formatted Storage Capacity in Mbytes | Height | Plated Media | Average Access | Comments | PC or PC/XT | AT |
|---|---|---|---|---|---|---|
| 10 | ½ | no | 85 msec | Low power | $ 295 | N/A |
| 21 | ½ | yes | 85 msec | Low power | Call | Call |
| 32 | Full | no | 30 msec | CDC WREN II drive | $1,295 | $1,195 |
| 72 | Full | no | 25 msec | Ideal AT drive for LAN | $1,795 | $1,695 |
| 144 | Full | no | 30 msec | 2 72MB drives as one volume | † | $3,395 |
| **Removable Hard Disk** | | | | | | |
| 10 | ½ | yes | 90 msec | 5 Mbits/s | $1,095 | $1,095 |

**Tape Systems and Subsystems**

| Formatted Storage Capacity | Height | Data Transfer Rate (k sec) | PC or PC/XT | AT |
|---|---|---|---|---|
| 60 Mbytes | ½ | 88 | $ 795 | $ 795 |
| 60 Mbytes Subsystem | | 88 | $ 1,045 | $ 1,045 |
| 21 Mbytes (unformatted) Start/stop Subsystem | | 24 | $ 445 | $ 445 |
| 26 Mbytes Floppy Tape® Subsystem | | 31 | $ 695 | $ 695 |

**Controllers**
All of our hard disk and tape controllers are available separately. Please call for prices.

**Subsystem Chassis†**
Any of our disk or tape units are available in an external subsystem for an additional $250.00. You can mix & match any of our ½ high hard disks or tape drives together or add any single full height hard disk.

**Power Supply**
150 Watt Power supply $75.00‡

‡with any purchase of PC or PC XT replacement

can backup by date, time, archive bit (since you last used a file), by subdirectory, file name or groups of files, or any name combination using DOS wild cards. Furthermore, you can schedule your backup for anytime you return to DOS, or at specific times.

If you're worried about 20 megabytes not being enough space, we include Express Systems file compression software, File Compactor,™ which compress binary files 30-35 percent, text files 40-50 percent, and data base files up to 90 percent of their original space. And not only will you not have to think about backing up your files, the AT Backup DiskCard will do it file-by-file at the rate of 3 megabytes per minute.

## Compatibility

The Express Hard DiskCard is compatible with most IBM PC or XT compatible computers, including but not limited to, all Leading Edge®, all Compaq® computers, AT&T 6300, Sperry, Zenith, Epson, and most others. And all of the cards can work with the IBM PC's 65 watt power supply.

## Upgradable

If you already own an Express Systems Hard DiskCard, you can upgrade to any of our larger Hard DiskCards. Call for details.

## Warranty

The Express Hard DiskCard comes with a 90 days to two year warranty, depending on the model.

## Quick Delivery

Order today and you'll receive your Hard DiskCard by Federal Express®. The next day or the day after—you decide.

For the best buy in a convenient, easy to install hard disk, call Express Systems.

*Uses IBM AT or compatible controller.
**Available only for the IBM AT or compatible.
***For IBM AT and compatibles, the interleave factor is dependent on its controller.
§Takes up 1½ slots and works beside any ½ slot board such as floppy controller.

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**In Illinois, call (312) 882-7733 Ext. 3500**

Express Systems, Inc., 1254 Remington, Schaumburg, IL 60195

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- 80B8-2 CPU — Runs at 4.77 or 7.4 MHZ
- 640K RAM
- 360K Half-Height Floppy Drive w/Controller
- Runs All Major PC-DOS Software
- AT™ Style Keyboard
- 135 Watt Power Supply
- System Manual
- MS-DOS 3.10
- Full 16 Month Warranty

**$659**

### AT™ System

- 80286 Processor (Switchable 6/8 Mhz)
- 512K RAM (1024K Optional)
- 1.2 MB Half-Height Floppy Disk Drive
- Floppy/Hard Disk Controller Card
- Clock/Calendar w/Battery Backup
- Runs All Major PC-DOS Software
- 200 Watt Power Supply
- AT™ Style Keyboard
- System Manual
- MS-DOS 3.10
- Full 18 Month Warranty

**$1259**

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Basic System Plus
- Monochrome Graphics Adapter
- 12" TTL Monochrome Monitor

XT $859
AT $1459

### Color System
Basic System Plus
- Color Graphics Adapter
- 13" RGB Color Monitor (640 x 200)

XT $1059
AT $1659

### EGA System
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- 13" High-Res RGB Color Monitor (640 x 350)

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AT $1939

**$99**

### Turbo Speed Hard Disk Controller

- 1:1 Interleave Lets Hard Drive Run at Full Speed
- Up To 6 times Faster Than Standard Controller
- No Hardware Setup Required

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### Tiny Turbo Card

- High-Speed Accelerator for PC and PC/XT
- Replaces 8086 with 80286
- Socket for 80287 on Board
- Short Card

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### Hayes Compatible Modem

- 300 & 1200 BPS
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- Fully Hayes Compatible

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- 200 CPS Draft / 60 CPS NLQ
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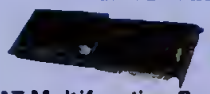

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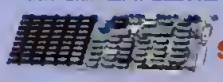
### AT Multifunction Card

- Expandable to 3 MB — 1.5 MB on Board, 1.5 MB on Piggyback Board (OK Installed)
- Supports 64K & 256K RAM Chips
- Parallel, Serial and Game Ports

### AT Mini I/O Card $89

- Parallel, Serial and Game Ports



**$139**

### XT Multifunction Cards

- 384K RAM
- Optional FDC
- Parallel, Serial and Game Ports
- RAM Disk & Printer Spooler Software

### XT Mini I/O Card $89

- Parallel, Serial and Game Ports

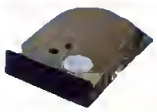
**$90**

### 135 Watt Power Supply

- XT Compatible
- UL Recognized (UR)
- Extra Power for Hard Drives

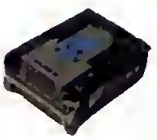
### Hard Disk Kit
20 MB - $399

- Boots from Hard Disk
- Instruction Manual
- Cables & Mounting Hardware
- Hard Disk Controller



### AT Type Hard Disk Drives
20 MB - $549
30 MB - $629
40 MB - $759

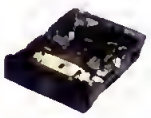
- Boot from Hard Disk
- Instruction Manual
- Cables & Mounting Rails
- Works w/AT Hard Disk Controller



### Floppy Disk Drive

- Half-Height
- 0S/00 — 360K
- Name Brands — TEAC, Panasonic, Mitsubishi, Sanyo, Etc.

$90



### Hard Disk Card
20 MB — $408

- 3½ Hard Card
- Easy Installation
- Formatted and Tested
- Boots From Hard Disk
- IBM XT Compatible

### Expension Box
$150

- Room for 3 Half-Height Drives
- 120 Watt Power Supply
- 5 Slot Bus

Host Bus Interface Cards w/Cable — $119

### Fast Tape Backup
20 MB — $449
60 MB — $725

- Easy Loading Tape Reels
- Responds to Standard DOS File Handling Commands
- Cables, Mounting Hardware and Tape Cartridge Included
- Software Included

### "IBM's Brother" Monochrome Monitor

- IBM Lookalike
- 12" Screen
- Amber or Green

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### High Resolution RGB Color Monitor

- 13" Screen
- 640 x 200 Resolution
- RGB — 16 Colors

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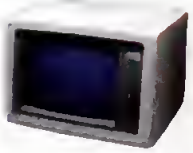
### EGA Compatible Color Monitor

- .31 mm Dot Pitch
- 13" Screen
- 640 x 350 Resolution
- RGB — 16 Colors

**$449**



### Mono-Graphics Adapter

- Hercules™ Compatible
- Parallel Port

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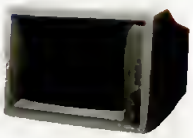
### Color Graphics Adapter

- 80 x 25 Character Text Mode
- 640 x 200 Dot Graphics Mode
- Fully IBM Compatible

$89



### EGA Card

- EGA, CGA, MDA & Hercules™ Compatible
- Flicker-Free Display

Short Card - Add $10

$249

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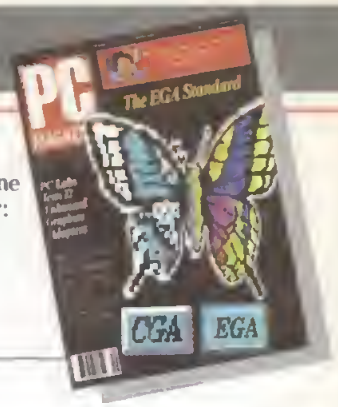


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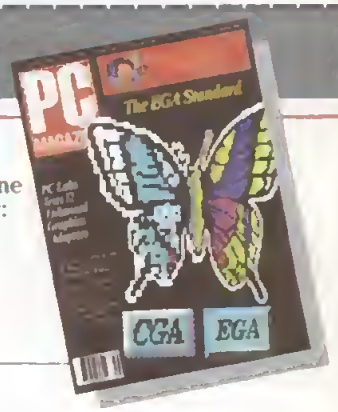


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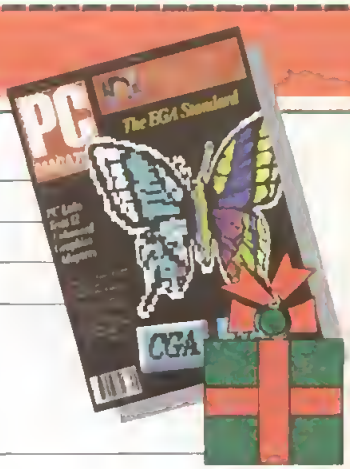


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M. F. Karparis
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Edward S. Kosciolek
Southport, CT
Paul Modrich
Durham, NC
Marina Ortega
Laredo, TX
D. Roberts
Neosho, MO
Alan Uomoto
Baton Rouge, LA
G. A. Wheeler
Marritt Island, FLA
Zachary Williams
Stone Mountain, GA
D. R. Woods
Tuscaloosa, AL

## SECOND PRIZE

**Tandy 200 Portable**

Stuart Altenhaus
Arlington, VA
R. R. Barron
Santa Clara, CA
Dianna Dahl
St. Louis, MO
Michael Dercks
Minneapolis, MN
R. Downham
San Jose, CA
Jerry Eisenberg
Gaithershurg, MD
Patsy Gatliff
Austin, TX
S. P. Geiger
Poughkeepsie, NY
Joann Grant
Lafayette, IN
Don Grassmann
Durham, NC
Jack W. Hoke
Redmond, OR
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Jim Petz
East Detroit, MI
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New Haven, CT
D. W. Saffel
Elkins, WV
S. Stephens
New York, NY
J. Stokes
Dayton, OH
John Treggiari
Dracut, MA
James G. Vernon
Flower Mound, TX
P. Zahorosky
Garfield, NJ

## THIRD PRIZE

**Sanyo Personal Cassette Stereo**
**100 Winners**

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John R. Anderson
Emeryville, CA
K. W. Anderson
Seattle, WA
Joseph D. Andose
Rahway, NJ
Shane D. Arvidson
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■ CHARLES PETZOLD

# PC TUTOR

*How to slow down a PC AT; DOS 3.0/WordStar incompatibility; different ways DOS uses to exit from assembly language programs.*

## SLOWING DOWN THE AT

I've seen a lot of things in *PC Magazine* about speeding up the PC AT. But my AT is too fast for some of the games written for the PC. Is there any way I can slow it down so I have a fighting chance with these programs?

Raphael Salgado
Valley Cottage, New York

*Well, this is a refreshing change, and not very difficult. It's generally much easier to slow something down than speed it up.*

*SLOWDOWN is a resident program that intercepts interrupt 8, the timer interrupt. The timer interrupt occurs every 55 msec. Normally, interrupt 8 doesn't do very much, so it doesn't significantly alter the speed of your computer. SLOWDOWN, however, executes a small loop every 55 msec to slow down the overall speed of the machine.*

*You can create SLOWDOWN.COM by getting into DEBUG and typing in the lines shown in Figure 1. You don't need to type the semicolons or the comments following them.*

*You use SLOWDOWN by executing*

```
SLOWDOWN value
```

*where* value *is a number from 0 through 65535. This is the value SLOWDOWN uses for the loop. The higher the number, the slower your AT will run. A value of 20000 or 25000 will slow down an 8-MHz AT to about the speed of a 4.77-MHz PC or XT. (It's not possible to mimic a PC or XT exactly because the 80286 microprocessor has different speed advantages depending upon the instruction mix.)*

*You can execute SLOWDOWN more than once, in which case the loop values will accumulate. For instance,*

```
SLOWDOWN 10000
SLOWDOWN 10000
SLOWDOWN 5000
```

*is the same as*

```
N SLOWDOWN.COM
A
JMP     0118            ; Jmp INIT
DW      0,0
DW      1
PUSHF                   ; NEWINT8:
CS:
CALL    FAR [0102]      ; Do OLDINT8
PUSH    CX
CS:
MOV     CX,[0106]       ; Loop Value
LOOP    0114
POP     CX
IRET
SUB     AX,AX           ; INIT:
MOV     SI,005D         ; Parameter
MOV     CX,000A         ; Ten
SUB     BH,BH
MOV     BL,[SI]         ; NUMLOOP:
INC     SI
CMP     BL,20           ; See if space
JZ      0133            ; Jz DONE
MUL     CX
SUB     BL,30
ADD     AX,BX
JMP     0122            ; Jmp NUMLOOP
ADD     [0106],AX       ; Save it
MOV     AX,3508         ; Get Int 8
INT     21
MOV     [0102],BX       ; Save it
MOV     [0104],ES
MOV     DX,0108         ; Set Int 8
MOV     AX,2508
INT     21
MOV     DX,0118
INT     27              ; Terminate

R CX
51
W
Q
```

**Figure 1:** *By typing these lines into DEBUG, you can create SLOWDOWN.COM, a program that will slow down your PC AT.*

```
SLOWDOWN 25000
```

*To get back to normal speed, you'll have to reboot. (You can also remove SLOWDOWN from memory with a RAM-resident manager like* PopDrop.*)*

*Given a high enough loop value, SLOWDOWN's loop will itself take 55 msec. As soon as the loop completes, another interrupt 8 will start it all over again. This will slow down the machine to almost a dead crawl. (TSO users on IBM mainframes will experience some déjà vu when this happens.) On an 8-MHz AT, this happens with a loop value of about 36300.*

*With loop values higher than this, the 8-MHz AT will start to speed up again, but it will be jumpy and do things in rhythmic spurts. This occurs because the loop takes longer than 55 msec, and the AT is starting to skip interrupt 8s. Your PC's clock will also start losing time.*

*SLOWDOWN cannot be used with programs that must be booted from diskettes. Note also that some programs may disable interrupts for a while, grab interrupt 8 themselves, and even reprogram the 8254 timer chip. SLOWDOWN won't work right with such programs.*

*A note to programmers: If you need to do gamelike animation in your programs, don't use delay loops. Poll the timer values to pace the program, or grab interrupt 1Ch and make the program timer-driven.*

## CHANGING DRIVES IN WORDSTAR

I recently upgraded my PC from DOS 2.1 to DOS 3.0, and I'm having a problem with *WordStar*. When I try to change the

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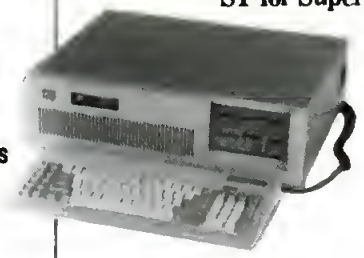

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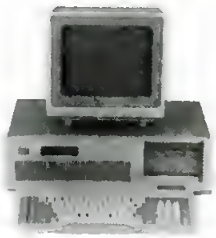

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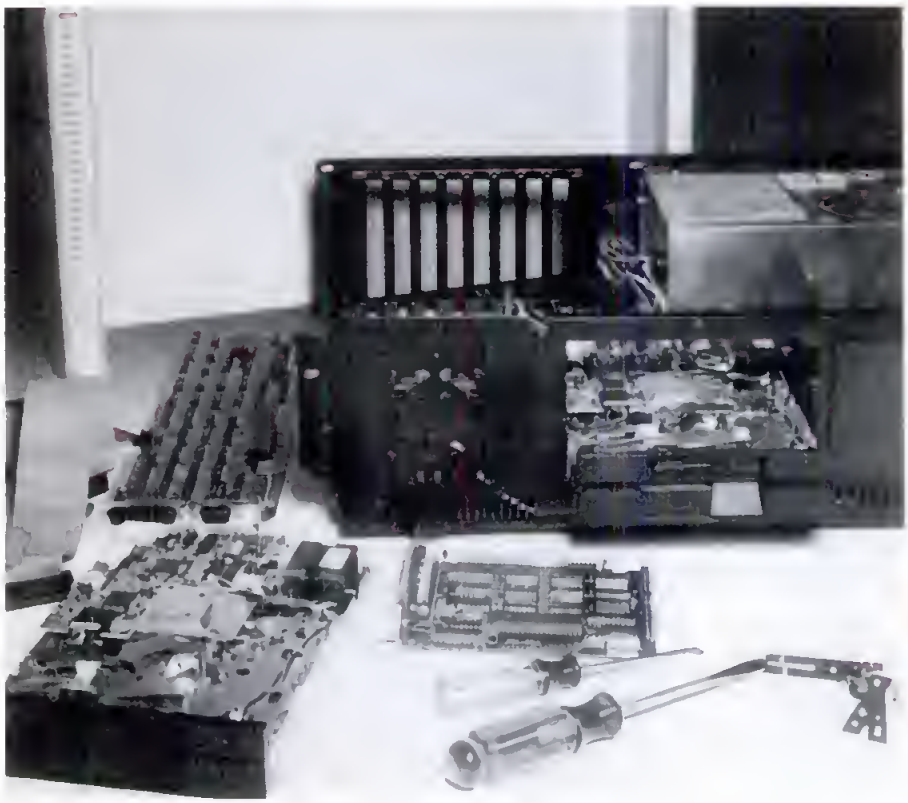

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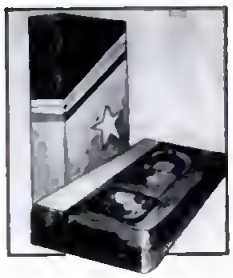

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## ■ PC TUTOR

logged disk drive with the "L" command, the file list on *WordStar*'s opening menu is not displayed and I can't call any files from the new drive. I've had to continue using DOS 2.1 with *WordStar*, but the arrangement is less than satisfactory. Is there a patch to *WordStor* to make it function properly under DOS 3.0?

George V. Ludwig
Madison, Wisconsin

*It's not a* WordStar *problem—it's o DOS 3.0 bug.* WordStar *will work fine under DOS 3.1 or 3.2. I wish I could tell you obout IBM's great update policy for replacing buggy DOS versions at minimal charge, but upgrading to a new DOS still meons putting out the bucks for it.*

### EXITING ASSEMBLY LANGUAGE PROGRAMS

Can you briefly explain some of the differences between DOS interrupts and DOS function calls that do the same thing? I'm thinking mostly about interrupt 20h versus interrupt 21h function call 4Ch (which exits a program) and interrupt 27h versus interrupt 21h function call 31h (which exits a program and remains resident).

If I use one or the other, to what extent will I lose compatibility with older or newer DOS versions? Do the newer calls work more quickly or reliably?

Paul G. Wing
Des Plaines, Illinois

*DOS provides several different ways to exit an assembly language program, and they ore all pretty much the same.*

*Under all versions of DOS, the most common method is the INT 20h command. But you can also use*

```
MOV AH,Ø
INT 21h
```

*The first 2 bytes of the Program Segment Prefix (PSP) that DOS builds at the beginning of oll progroms looded into memory contoin the machine code for an INT 20h (the bytes CD 20h). For a .COM program, DOS pushes o word of zeros on the stack before it turns control over to the program. Thus (assuming that the stack pointer is the same as it was on entry to the program) o .COM program can terminate with o simple RET instruction. This branches to the beginning of the PSP ond executes the INT 20h instruction.*

■ Function calls 4Ch and 31h are now the "preferred" methods for exiting assembly language programs.

*Using this fact, you can create the shortest possible .COM progrom (1 byte long) thus:*

```
CSEG    SEGMENT
        ASSUME CS:CSEG
        ORG Ø1ØØh
ENTRY:  RET
CSEG    ENDS
        END ENTRY
```

*You can also exit a .COM program by branching to the beginning of the Program Segment Prefix directly. If the beginning of your program looks like this:*

```
CSEG    SEGMENT
        ASSUME CS:CSEG
ZERO:
        ORG Ø1ØØh
```

*you can exit it with either*

```
JMP ZERO
```

*or*

```
CALL ZERO
```

*Prior to DOS 2.0, interrupt 20h presented some problems for .EXE programs. Interrupt 20h requires the value of the CS (Code Segment) register to point to the beginning of the Program Segment Prefix. In the general case, this is not true for .EXE programs. On entry, however, the value of the DS (Doto Segment) register points to the PSP. So, to use interrupt 20h, .EXE programs have to execute code that looks something like this:*

```
PUSH DS
MOV AX,Ø
PUSH AX
```

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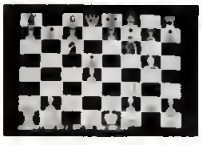

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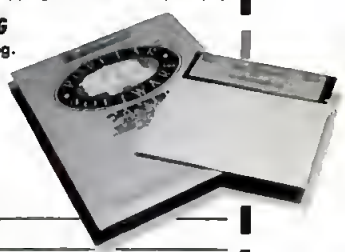

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## ■ PC TUTOR

*This code puts the far address (segment plus offset) of the beginning of the PSP on the stack. The .EXE program can then exit with a*

RET

*within a far procedure. This effectively branches to the INT 20h instruction at the beginning of the PSP.*

*Beginning with DOS 2.0, interrupt 21h function call 4Ch was added. This function call has two advantages over interrupt 20h. First, it does not require that the CS register point to the PSP. Second, a program can pass back a return call (in register AL) to DOS. This return code can be used in a batch file IF ERRORLEVEL statement. Or, if the program is executed through function call 4Bh as a child process of another program, the parent program can retrieve the return code through function call 4Dh.*

*Aside from these advantages over interrupt 20h, however, the two termination methods are functionally about the same. I've just taken a look in DOS 3.2 and have found that DOS turns an interrupt 20h into an interrupt 21h function call 0. Function calls 0 and 4Ch both execute a few lines of code on their own but then share the bulk of the DOS code involved in terminating programs.*

*The story is similar for interrupt 27h. By setting register DX to the end of the program and executing an INT 27h, a program can terminate but remain resident. This works for all DOS versions. Interrupt 27h is a problem with .EXE programs because CS must again point to the beginning of the PSP. I've seen at least one .EXE program that remained resident by putting a 27h in the second byte of the PSP and then terminated with a far RET.*

*Beginning with DOS 2.0, interrupt 21h function call 31h can also be used to terminate and remain resident. Here register DX is the size of the program in paragraphs. (A paragraph is 16 bytes.) By using a paragraph size rather than a byte size, function call 31h allows a program larger than 64K to remain resident in memory. Like function call 4Ch, you can also pass back a return code with function call 31h. But again, interrupt 27h and function call 31h share a lot of DOS code.*

*Function calls 4Ch and 31h are now the "preferred" methods for exiting assembly language programs, but only because they are more flexible than interrupts 20h and 27h. The only problem with these methods is that these two function calls don't work under DOS 1.1. Although DOS 1.1 is nearly extinct, if the rest of your program can run under DOS 1.1, it would be silly to terminate with a function call not supported by DOS 1.1.*

■ Some people believe that interrupts 20h and 27h will be eliminated in future versions of DOS.

*Some people believe that interrupts 20h and 27h will be eliminated in future versions of DOS. For instance, the Microsoft Press* MS-DOS Technical Reference Encyclopedia *(which was recalled about a month after it was released because of gross errors) describes interrupts 20h and 27h as "obsolete." It also says that programs that remain resident in memory should use function call 31h to "ensure compatibility with future versions of DOS." (Really? Is that all that's necessary to be compatible with future DOS versions? Isn't that what "ensure" means?)*

*Believe me, if a future DOS version must eliminate interrupts 20h and 27h, this will be the least troublesome of the changes you'll have to make to your assembly language programs. I'm working under the assumption that the future 80286 protected-mode version of DOS (which is really the only future DOS version that matters) will require you to make changes in* all *assembly language programs, and that your programs written in high-level languages may only have to be recompiled and relinked.*

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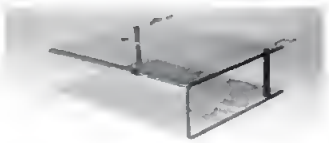

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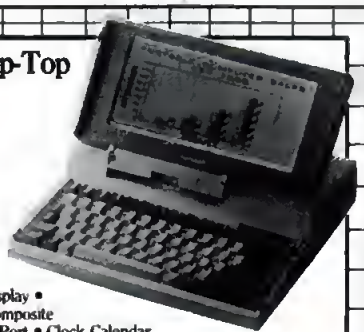

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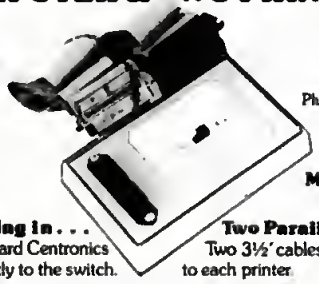

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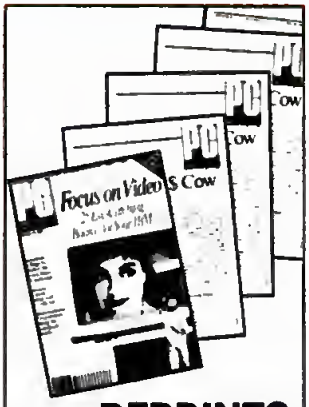

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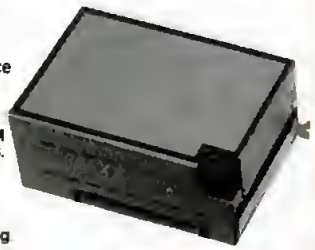

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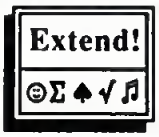


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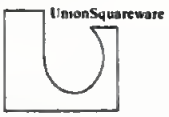


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| PCT-AT 1.0–6/8 Mhz | $1395.00 |
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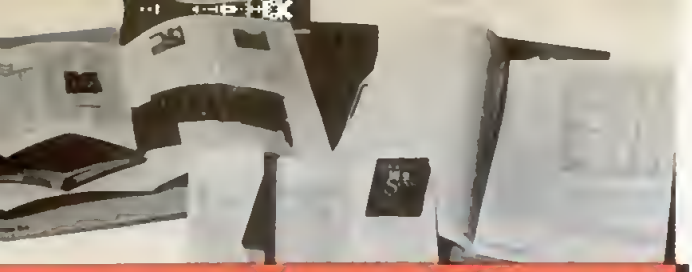

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Just complete the attached card. We'll notify the manufacturers or distributors so you can receive your free brochures directly from them.

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***Hardware***

a. ☐ Mainframe
b. ☐ Mini
c. ☐ PC
d. ☐ Printers/Plotters
e. ☐ Monitors
f. ☐ Terminals
g. ☐ Modems
h. ☐ Hard Disk/Tape Back-up
i. ☐ Add-in Boards
j. ☐ LANS
k. ☐ Micro-Mainframe Links

***Software***

l. ☐ Communications
m. ☐ Accounting
n. ☐ Spreadsheets/Financial Planners
o. ☐ Project Managers
p. ☐ Word Processors
q. ☐ Database Managers
r. ☐ Graphics

**2) Your primary job function is (check)**

s. ☐ Administrative/General Management
t. ☐ MIS/DP, Communications Systems, Programming
u. ☐ Engineering/R&D
v. ☐ Finance/Accounting
w. ☐ Marketing/Sales

**3) Next step after information is received:**

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y. ☐ Evaluation
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## HOW TO STAY ON TOP OF WHAT'S WHAT IN THE PC MARKET

Are you frequently called upon to give advice about PC products? Is it your responsibility to make PC hardware, software and peripherals selections?

If so, there are probably products or services in this issue you wish you knew a little more about.

Well, all you have to do is send in your PC Magazine reader service card. You just circle the number that corresponds to the ad or article that interested you. We'll forward your name to the manufacturers or distributors so they can send you the literature you need.

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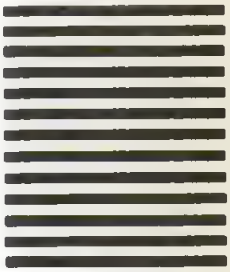

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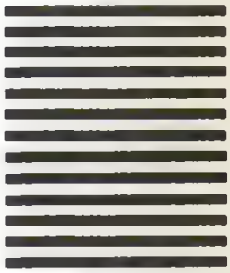

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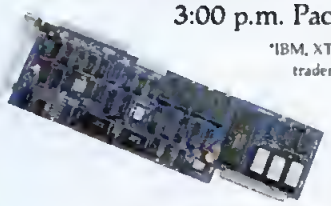

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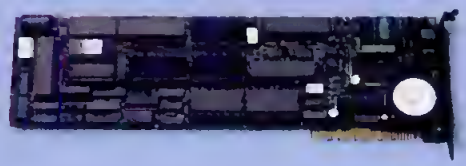

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PC MAGAZINE

# COMING UP

**COMPLETE LAPTOP ROUNDUP** Everyone wants to take DOS on the road, and the advantages of doing so are many, especially when the portable PC in your lap is lightweight and its screen is legible. Since last July, when *PC Magazine* surveyed the portable computer scene, a flurry of new arrivals and improvements have made your buying decisions more complicated than ever. In this complete roundup, Jon Pepper and our own editorial staff take a close look at eight new laptops, and capsule reviews from the first laptop survey remind you of reviewers' reactions to the earlier collection. Also included: an updated features table covering all the laptops and a look at regulations governing use of portable computers in airplanes.

**MULTIPORT SERIAL CARDS** Here's an idea whose time has come: cards that provide your PC with four to eight extra serial ports. Winn L. Rosch reviews five multiport serial cards of both the "intelligent" and "dumb" types and explains the advantages in flexibility that custom-designed operating software can offer.

**BUSINESS GRAPHICS** It's a struggle to keep up with the latest advances in graphics packages, but in today's PC-dominated offices, it's a must. Marvin Bryan tests five top-of-the-line programs for ease of use and plotter output. The colorful results may surprise you.

**PRESENTATION PACKAGES** If you're looking for an easier way to create an effective tutorial, an eye-catching marketing demo, or a high-impact presentation for the board of directors, one of these five presentation packages may be just what you need. Slide shows will never be the same again.

**HIGH-RESOLUTION MONITORS** Wyse and Moniterm go head-to-head in a test of high-resolution monitors running *Microsoft Windows*.


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| COMPAQ DeskPro w/640K 30 meg | 2189.50 |
| COMPAQ Portable II Model II | 2523.69 |
| COMPAQ Portable II Model IV | 3499.50 |
| COMPAQ "286" DeskPro. 256K 1 floppy | 2150.60 |
| COMPAQ "286" DeskPro w/30 meg | 2995.30 |
| COMPAQ "286" DeskPro w/30 meg 512K tape | 3578.60 |
| COMPAQ "286" Portable w/20M 640K | 3860.30 |
| COMPAQ "286" Portable w/20M 640K tape | 4292.30 |
| COMPAQ "386" DeskPro New Model | SAVE |

**AT&T SPECIALS**

| | |
|---|---|
| AT&T 6300 w/128K 1 drive | $1699.81 |
| AT&T 6300 w/256K 2 drives | 1849.24 |
| AT&T 6300 w/256K 1 floppy 20 meg hard drive | 2174.23 |

All AT&Ts include monitor, keyboard and DOS

**TOSHIBA SPECIAL**

| | |
|---|---|
| TOSHIBA 1100+, 3100 | SAVE |

**SHARP SPECIAL**

| | |
|---|---|
| 2 Drive Portable (IBM PC Compatible) | $1154.93 |

**NEC APC IV SPECIALS**

| | |
|---|---|
| NEC APC IV AT compatible 1 2 Floppy 1 Meg Memory | From $1950.00 |
| NEC APC IV 20 meg hard drive | 2279.35 |
| NEC APC IV 40 meg hard drive | 2595.15 |
| NEC APC IV 70 meg hard drive | 3167.65 |

**WYSE PC SPECIALS**

| | |
|---|---|
| WYSE PC 1 drive | $989.80 |
| WYSE PC 1 drive 20 meg | 1320.48 |
| WYSE PC 1 drive 40 meg | 1779.70 |

**ZENITH SPECIALS**

| | |
|---|---|
| ZS-158 1 drive 256K S slots w/DOS | $1263.60 |
| ZS-171 Laptop 2 drives 256K 1S lbs | 1684.80 |
| ZS-241 S12K 1 2 meg floppy AT Compat | 2457.00 |

Other Computers Available Upon Request

### TERMINALS

**KIMTRON**

| | |
|---|---|
| 14" Green or Amber w/AT keyboard | $449.07 |
| 12" Green or Amber w/AT keyboard | 399.50 |

**QUME**

| | |
|---|---|
| 119G 14" Green emulates WYSE and ADDS | $454.44 |
| 101G, 101A 14" emulates Televideo and Hazeltine | 307.54 |

**WYSE**

| | |
|---|---|
| WY-30 14" emulates ADDS and Televideo | $289.10 |
| WY-50 14" Green emulates ADDS Hazeltine and Televideo | 429.44 |
| WY-50+ Amber multi-unit emulation | 479.20 |
| WY-7S DEC VT-100 and Unix compatible | 577.60 |
| WY-85 DEC VT-100 & VT-220 compatible | 449.20 |

### TAPES AND DRIVES FOR IBM ATs

| | |
|---|---|
| 30 meg Seagate hard disk | $559.80 |
| 70 meg hard disk | 1259.00 |
| 360K floppy drive | 110.12 |
| GENOA 20 meg internal tape | 508.82 |
| GENOA 20 meg external tape | 636.02 |

### PRINTERS

| | |
|---|---|
| CITIZEN MSP10 | $275.20 |
| CITIZEN MSP20 | 334.92 |
| EPSON LX 86 80 Col 100 CPS NLQ STD | 299.81 |
| EPSON EX 1000 | 655.56 |
| EPSON EX 800 | 466.76 |
| EPSON FX 85 | 342.50 |
| EPSON FX 286 | 469.19 |
| EPSON LQ 800 | 499.22 |
| EPSON LQ 1000 | 689.76 |
| EPSON LQ 2500 | 1018.44 |
| EPSON RX 100 | 209.90 |
| EPSON COMREX 420 132 Col 420 CPS | 899.89 |
| IBM Pro Printer | 429.40 |
| IBM Pro Printer XL | 542.67 |
| NEC P6 80 col | 449.22 |
| NEC P7 136 col 218 cps | 815.35 |
| NEC P5 136 col 290 cps | 999.67 |
| NEC 3550 Spinwriter | 797.12 |
| NEC 8850 Spinwriter | 1127.85 |
| OKI okimate 20 | 117.72 |
| OKI ML 182 | 234.50 |
| OKI ML 192 Plus | 344.80 |
| OKI ML 193 Plus | 519.40 |
| OKI ML 292 Plus | 424.44 |
| OKI ML 293 Plus | 547.55 |
| TOSHIBA P321 | 463.25 |
| TOSHIBA P341 | 599.99 |
| TOSHIBA P351 S/P | 999.06 |

### LASER PRINTERS

| | |
|---|---|
| CANON A1,A2 (in stock) | SAVE |
| CORONA Laser Printer | 2125.90 |
| H-P Laser Jet Printer | 2289.60 |
| H-P Laser Jet Plus | 2994.20 |
| H-P Laser Jet 500 Plus | 3687.10 |
| QUAD Laser | SAVE |

### FLOPPY & HARD DISK DRIVES

| | |
|---|---|
| 1/2 height drive | $98.00 |
| IBM Logo Drive | 99.73 |
| TANDON full height floppy drive | 109.87 |
| SEAGATE 20 meg 1/2 height hard drive | 395.00 |
| SEAGATE 30 meg full height w/controller | 670.00 |
| GENOA 20 meg internal tape | 588.82 |
| GENOA 20 meg external tape | 636.02 |
| GENOA 60 meg tape drives | CALL |
| IOMEGA BERNOULLI 10 + 10 | 1798.40 |
| IOMEGA BERNOULLI 20 + 20 | 2175.85 |
| IRWIN 19 meg tape backup | 399.00 |

### DRIVE CARDS

| | |
|---|---|
| MOUNTAIN 20 meg | $659.88 |
| MOUNTAIN 30 meg | 899.45 |
| MAYNARD 20 meg | 683.45 |
| WESTERN DIGITAL 10 and 20 meg | CALL |

Plus Other Drive Cards Available

### MODEMS, COMMUNICATIONS & EMULATIONS

| | |
|---|---|
| AST 5251-11 Plus | $639.04 |
| AST 5251-12 | 508.60 |
| EVEREX 12008 | 119.50 |
| HAYES 1200 | 392.08 |
| HAYES 12008 | 299.03 |
| HAYES 2400 | 575.00 |
| HAYES 2400B | 502.18 |
| IRMA 5250 (Smartalec) | 564.84 |
| IRMA 3278/79 Courier | 749.60 |
| US ROBOTICS Password 1200 | 228.85 |
| US ROBOTICS Microlink 2400 | 424.15 |
| US ROBOTICS Courier 1200 | 429.60 |
| VEN-TEL 1200 Courier | 314.80 |
| VEN-TEL 12008 | 314.80 |

### MONOCHROME MONITORS

| | |
|---|---|
| AMDEK 310A | $139.99 |
| COMPAQ monochrome monitor (green or amber) | 188.46 |
| IBM monochrome monitor | 219.84 |
| PGS MAX 12E amber color | 167.40 |
| MAGNAVOX Green or Amber | 89.95 |
| TAXAN 121 Green | SAVE |
| TAXAN 122 Amber | SAVE |

### MONITOR INTERFACE CARDS

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|---|---|
| CDW color card w/p | $ 99.00 |
| CDW mono card w/p | 99.00 |
| GENOA Spectrum (color monographic w/p) | 199.82 |
| HERCULES color card w/p | 144.18 |
| HERCULES monographics plus w/p | 179.84 |
| ST8 chauffeur w/p | 199.60 |

### COLOR GRAPHIC MONITORS

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|---|---|
| AMDEK color 600 (Hi Res RGB) | $399.97 |
| AMDEK color 722 | 499.78 |
| IBM color monitor | 528.77 |
| MAGNAVOX 14" RGB 640 x 200 | 289.00 |
| PGS HX-12 Hi-Resolution RGB | 412.32 |
| NEC Multisync | 589.04 |
| TAXAN 620-630-640s | IN STOCK |

### ENHANCED GRAPHICS PRODUCTS (EGA)

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|---|---|
| COMPAQ enhanced graphics monitor | SAVE |
| GENOA Spectra EGA 256K w/p | 287.60 |
| IBM enhanced graphics monitor | 679.41 |
| PARADISE Auto Switch EGA | 370.70 |
| PGS HX-12E Hi-Resolution RGB | 484.32 |
| QUADRAM EGA Card | 347.73 |
| ORCHID EGA | 329.94 |
| TAXAN 760 New EGA Model | 499.00 |

### INTERFACE CARDS & MULTI-FUNCTION CARDS

| | |
|---|---|
| APPARAT 64/384K w/Clock | $99.89 |
| AST 6 pack with 64K C/S/P expands to 384K | 166.24 |
| AST PREMIUM 6 pack 512K expands to 1 meg 2 ser 1 para game and clock | 364.25 |
| AST advantage for AT expands to 3 meg | 345.00 |
| AST I/O mini (clock/serial port) | 125.28 |
| INTEL above board for PC w/64K | 279.60 |
| INTEL above board for AT w/128K | 360.24 |
| JRAM-3 w/256K (Lotus 2.0 and Symphony compatible) | 360.24 |
| Parallel Port | 69.80 |
| QUADRAM Liberty w/64K | 245.41 |
| QUAD AT expands to 2 Meg | 325.43 |
| QUADRAM Quad Board expands to 384K 1 par 1 ser 1 game clock w/0K | 119.60 |
| QUADRAM Silver Quad expands to 384K 1 par 2 ser 1 game clock w/0K | 149.60 |
| Serial Port | 49.95 |
| ZUCKERBOARD expands to 576K w/OK/c | 89.95 |

### SOFTWARE

| | |
|---|---|
| BORLAND Sidekick (copy protected) | $29.40 |
| dBASE III Plus | 399.60 |
| FRAMEWORK II | 399.40 |
| LOTUS 1-2-3 New Release | 299.00 |
| LOTUS Symphony | 429.30 |
| MICROSOFT WORD 3.0 | 267.00 |
| WORDPERFECT | 206.20 |

### CHIPS

| | |
|---|---|
| 4164 (64K 150 nanoseconds) | $2.00 |
| Nine Chip Set (complete set) | 9.98 |
| 128K piggy backs for AT | 4.94 |
| Nine Chip Set (complete set) | 34.50 |
| 8087-2 (for COMPAQ DeskPro) | 149.33 |
| 8087-3 (for PC/XT/COMPAQ portable) | 121.50 |
| 80287-3 (for AT and AT Compatible) | 168.30 |
| 41256K (256K chips) | 4.00 |
| Nine Chip Set (complete set) | 28.12 |

### MISC. & ACCESSORIES

| | |
|---|---|
| A-B Switching Box (par. or serial) | $45.00 |
| BASF D/S D/D | 12.50 |
| BASF 3.5" Disk for MACINTOSH 10 pack | 19.99 |
| BASF Disks for AT (1.2 meg) | 26.14 |
| CH PRODUCTS game ports | 37.42 |
| KENSINGTON Masterpiece | 99.99 |
| KENSINGTON Masterpiece + . | 119.40 |
| KEYTRONICS S150 | 99.00 |
| KEYTRONICS 5151 PC or AT&T | 162.00 |
| MICROSOFT Mouse (BUS Version) | 119.34 |
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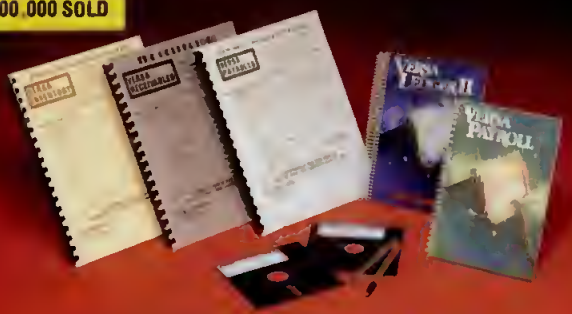

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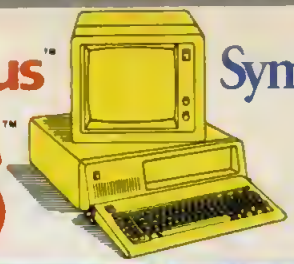

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